

**2008 Isuzu Ascender LS**

2008 STEERING Power Steering - Ascender, Envoy &amp; Trailblazer

**2008 STEERING****Power Steering - Ascender, Envoy & Trailblazer****SPECIFICATIONS****FASTENER TIGHTENING SPECIFICATIONS**

<b>Application</b>	<b>Specification</b>	
	<b>Metric</b>	<b>English</b>
Adjuster Plug Lock Nut	75 N.m	55 lb ft
Cylinder Line End Fitting	32 N.m	24 lb ft
Cylinder Line Retaining Plate	12 N.m	106 lb in
Flow Control Valve Fitting	75 N.m	55 lb ft
Inner Tie Rod Housing	100 N.m	74 lb ft
Lower Intermediate Shaft to Power Steering Gear Input Shaft Pinch Bolt	40 N.m	30 lb ft
Outer Tie Rod Retaining Nut	57 N.m	42 lb ft
Outer Tie Rod to Inner Tie Rod Jam Nut	75 N.m	55 lb ft
Power Steering Cooler Mounting Bolts	20 N.m	15 lb ft
Power Steering Gear to Frame Mounting Bolts	110 N.m	81 lb ft
Power Steering Hose Assembly to Frame Brackets Mounting Bolts	10 N.m	89 lb in
Power Steering Hose Assembly to Front Crossmember Bracket Mounting Bolt	10 N.m	89 lb in
Power Steering Hose Assembly to Power Steering Gear Retaining Bolt	12 N.m	106 lb in
Power Steering Hose Assembly (Pressure Hose) to Power Steering Pump	25 N.m	18 lb ft
Power Steering Hose Assembly to Wheel Well Bracket Mounting Bolt	10 N.m	89 lb in
Power Steering Pump Bracket Mounting Bolts	50 N.m	37 lb ft
Power Steering Pump Mounting Bolts	25 N.m	18 lb ft

**POWER STEERING PUMP SPECIFICATIONS**

<b>Vehicle</b>	<b>Engine Code</b>	<b>Engine Size</b>	<b>High Flow (Liters per Minute)</b>	<b>High Flow (Gallons per Minute)</b>	<b>Pressure Relief (kPa)</b>	<b>Pressure Relief (PSI)</b>
TrailBlazer, Envoy	LL8	4.2L	10.2/11.7	2.7/3.1	10342/11032	1500/1600
TrailBlazer Ext, Envoy	LL8	4.2L	11.7/13.2	3.1/3.5	10342/11032	1500/1600

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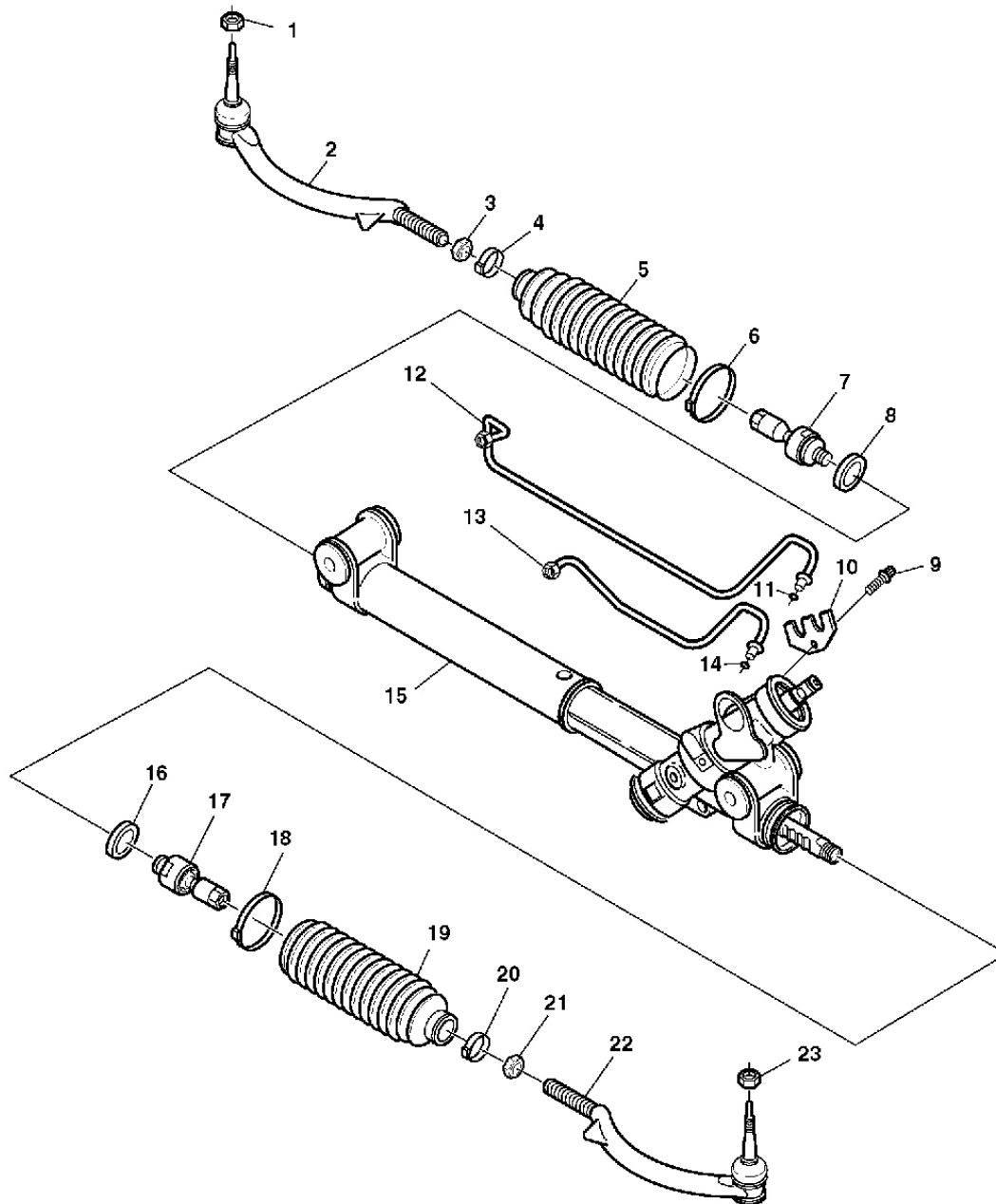
Ext						
TrailBlazer Ext, Envoy Ext	LH6	5.3L	11.7/13.2	3.1/3.5	10342/11032	1500/1600
TrailBlazer SS	LS2	6.0L	11.7/13.2	3.1/3.5	9652/10342	1400/1500
Rainier	LH6	5.3L	10.2/11.7	2.7/3.1	10342/11032	1500/1600

## COMPONENT LOCATOR

### POWER STEERING GEAR DISASSEMBLED VIEW

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**Fig. 1: Identifying Power Steering Gear Components**  
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Torque Prevailing Nut
2	Outer Tie Rod Assembly

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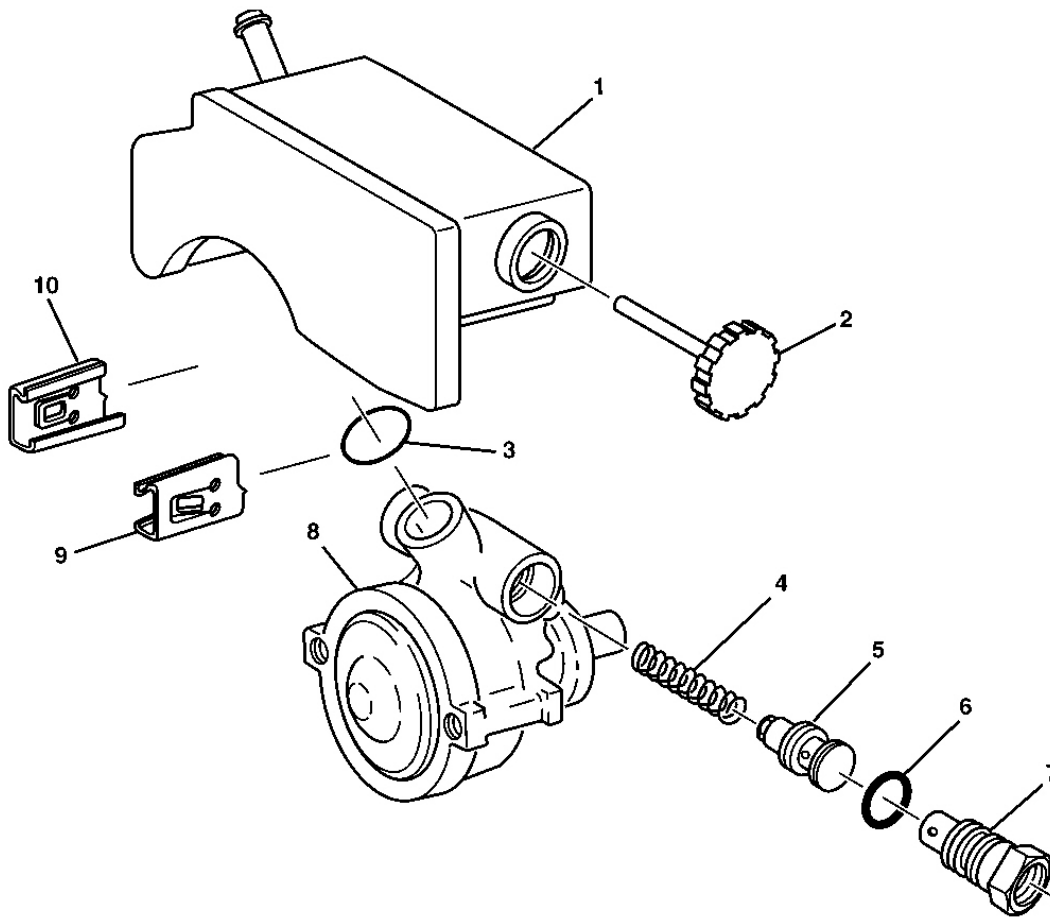
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3	Hexagon Jam Nut
4	Tie Rod End Clamp
5	Rack and Pinion Boot
6	Boot Clamp
7	Inner Tie Rod Assembly
8	Shock Dampener Ring
9	External TORX® Screw
10	Cylinder Line Retaining Plate
11	O-ring Seal
12	Cylinder (RH) Line
13	Cylinder (LH) Line
14	O-ring Seal
15	Rack and Pinion Gear (Partial)
16	Shock Dampener Ring
17	Inner Tie Rod Assembly
18	Boot Clamp
19	Rack and Pinion Boot
20	Tie Rod End Clamp
21	Hexagon Jam Nut
22	Outer Tie Rod Assembly
23	Torque Prevailing Nut

**POWER STEERING PUMP DISASSEMBLED VIEW (CB SERIES PUMP)**

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**Fig. 2: Exploded View Of Power Steering Pump Components (CB Series)**  
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Hydraulic Pump Reservoir Assembly (Typical)
2	Reservoir Capstick Assembly
3	O-Ring Seal
4	Flow Control Spring
5	Control Valve Assembly
6	O-Ring Seal
7	O-Ring Union Fitting
8	Hydraulic Pump Housing Assembly
9	Reservoir Retaining Clip (RH)
10	Reservoir Retaining Clip (LH)

## DIAGNOSTIC INFORMATION & PROCEDURES

### DIAGNOSTIC STARTING POINT - POWER STEERING SYSTEM (W/O ELECTRO-HYDRAULIC STEERING)

Begin the system diagnosis by reviewing the system Description and Operation. Refer to **Power Steering System Description and Operation (w/o Electro-Hydraulic Steering)**. Reviewing the Description and Operation information will help you determine the correct symptom diagnostic procedure when a malfunction exists. Reviewing the Description and Operation information will also help you determine if the condition described by the customer is normal operation. Refer to **Symptoms - Power Steering System** in order to identify the correct procedure for diagnosing the system and where the procedure is located.

### SYMPTOMS - POWER STEERING SYSTEM

Review the system description and operation in order to familiarize yourself with the system functions. Refer to **Power Steering System Description and Operation (w/o Electro-Hydraulic Steering)**.

#### Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- Inspect for leaking power steering components. If necessary, refer to **Power Steering Fluid Leaks**.
- Verify the power steering fluid level per operating specification. Refer to **Checking and Adding Power Steering Fluid**.
- Inspect the power steering fluid for the following indications of contamination:
  - Milky fluid - water
  - Brown fluid - burnt
  - Debris in fluid - plastic or dirt
- If necessary, flush the power steering system. Refer to **Power Steering System Flushing**.

#### Symptoms List

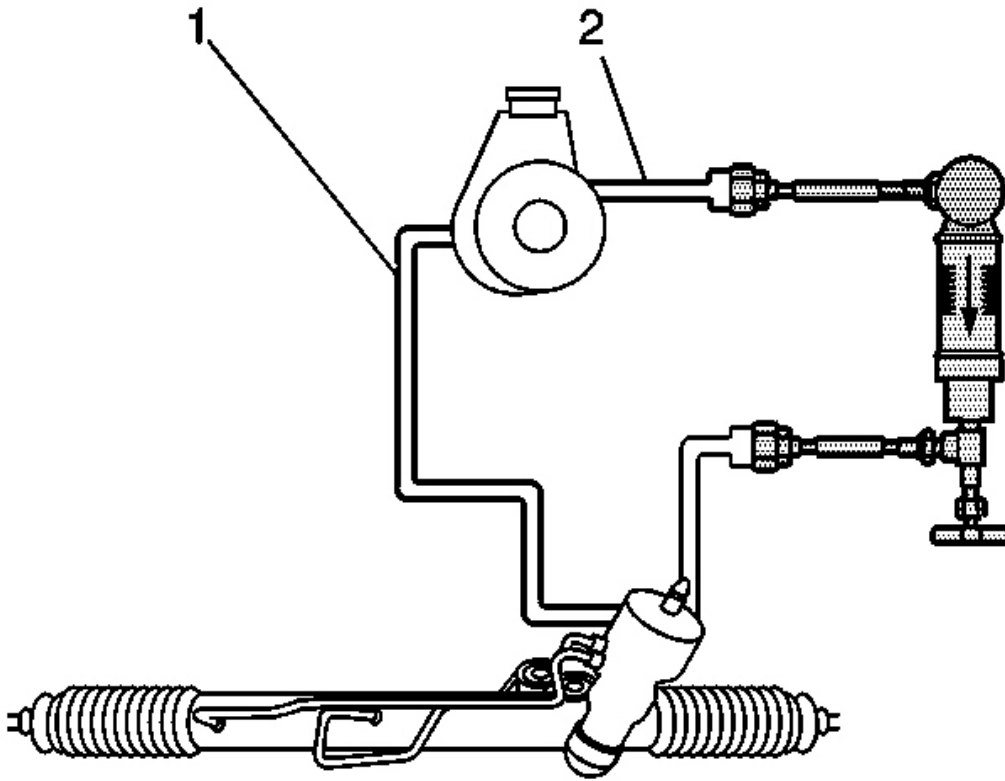
Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Steering Fluid Leaks**
- **Rattle, Clunk, or Shudder Noise from the Power Steering System (4.2L)** or **Rattle, Clunk, or Shudder Noise from the Power Steering System (Except 4.2L)**
- **Whine or Growl Noise from the Power Steering System**
- **Steering Effort Hard in One or Both Directions**
- **Steering Effort Too Easy in One or Both Directions**

### POWER STEERING SYSTEM TEST

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**Fig. 3: Testing Rack & Pinion System Pressures**  
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Power Steering Return Hose
2	Power Steering Pressure Hose

### Test Description

The numbers below refer to the step numbers on the diagnostic table.

**5:** This step tests the system for restrictions.

**7:** This step tests the following components for the following conditions:

- The pump for internal leaks
- The power steering pipes for kinks

**8:** This step tests the ability of the pump to regulate flow at maximum pressure.

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**10:** This step tests the ability of the pump to regulate flow under normal operating conditions.

**12:** This step tests the internal components of the pump and the gear.

Step	Action	Value(s)	Yes	No
<b>DEFINITION:</b> The Power Steering System Test Procedure will perform the following functions: <ul style="list-style-type: none"> <li>• Test the operation of the hydraulic power steering system.</li> <li>• Test the operation of the power steering pump and power steering gear.</li> <li>• Identify restrictions in the system.</li> </ul>				
1	Inspect the power steering fluid for the following indications of contamination: <ul style="list-style-type: none"> <li>• Milky fluid - water</li> <li>• Brown fluid - burnt</li> <li>• Debris in fluid - plastic or dirt</li> </ul> Is the fluid free of contamination?	-	Go to <b>Step 3</b>	Go to <b>Step 2</b>
2	Flush the power steering system. Refer to <b><u>Power Steering System Flushing</u></b> . Did you complete the procedure?	-	Go to <b>Step 3</b>	-
3	<b>IMPORTANT:</b> <b>In order to accurately diagnose the system, the malfunction must be present during the test procedure.</b>  Attempt to duplicate the condition. Is the condition present?	-	Go to <b>Step 4</b>	System OK
4	<ol style="list-style-type: none"> <li>1. Turn the ignition switch to the OFF position.</li> <li>2. Place a drain pan under the vehicle in order to catch any power steering fluid.</li> <li>3. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary.</li> <li>4. Install the <b>J 44721</b> Power Steering System Analyzer. See <b><u>Special Tools</u></b>.</li> <li>5. Fill the power steering system. Refer to <b><u>Checking and Adding Power Steering Fluid</u></b>.</li> </ol> Did you complete the installation?	-	Go to <b>Step 5</b>	-
	<ol style="list-style-type: none"> <li>1. Fully open the <b>J 44721</b> valve. See <b>Special</b></li> </ol>			



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5	<p><b><u>Tools.</u></b></p> <p>2. Start the engine.</p> <p><b>NOTE:</b> <b><u>Refer to Steering Wheel in the Full Turn Position Notice .</u></b></p> <p>3. Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system.</p> <p>4. Inspect and ensure that all of the power steering pipe/hose connections are not leaking.</p> <p>5. Ensure that the steering wheel is OFF the steering stop. Observe the pressure reading.</p> <p>Is the pressure reading greater than the specified value?</p>	1 379 kPa (200 psi)		
6	<p><b>IMPORTANT:</b> <b>A restriction may be present in the power steering system. Turn OFF the engine IMMEDIATELY.</b></p> <p>Locate and repair the restriction.Did you complete the repair?</p>	-	Go to <b>Step 6</b>	Go to <b>Step 7</b>
7	<p>1. Allow the engine to run until the engine reaches full operating temperature.</p> <p>2. Record the pressure reading and flow reading.</p> <p>3. Partially close the <b>J 44721</b> valve until the system pressure reaches the specified value, then record the FLOW reading. See <b><u>Special Tools.</u></b></p> <p>4. Subtract second flow reading from the first flow reading.</p> <p>Is the flow DECREASE greater than 3.8 L (1 gal) per minute?</p>	4 827 kPa (700 psi)	Go to <b>Step 13</b>	Go to <b>Step 8</b>
	<p><b>NOTE:</b> <b>Do not leave the valve fully closed for more than 5 seconds, or the pump could be damaged internally.</b></p>			

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8	Fully close then open the <b>J 44721</b> valve 3 times. See <b>Special Tools</b> . Record all of the high pressure readings. Refer to <b>Power Steering Pump Specifications</b> for power steering system pressure relief specifications. Are the 3 high pressure readings within specifications?	-	Go to <b>Step 9</b>	Go to <b>Step 15</b>
9	Are the 3 high pressure readings within 245 kPa (50 psi) of each other?	-	Go to <b>Step 10</b>	Go to <b>Step 14</b>
10	<ol style="list-style-type: none"> <li>1. Increase the engine speed to approximately 1,500 RPM.</li> <li>2. Record the flow reading. Refer to <b>Power Steering Pump Specifications</b> for power steering system pressure specifications.</li> </ol> <p>Is the actual flow reading within specifications?</p>	-	Go to <b>Step 11</b>	Go to <b>Step 13</b>
11	Is the difference between the actual flow reading and the maximum flow specification more than 3.8 L (1 gal) per minute?	-	Go to <b>Step 16</b>	Go to <b>Step 12</b>
12	<p><b>NOTE:</b> Refer to <b>Steering Wheel in the Full Turn Position Notice</b> .</p> <p>Turn the steering wheel from steering stop to steering stop and record the FLOW readings at each stop. Is the flow LOWER than 3.8 L (1 gal) per minute?</p>	-	Go to <b>Step 18</b>	Go to <b>Step 17</b>
13	<p>Replace the power steering pump. Refer to <b>Power Steering Pump Replacement (4.2L)</b> or <b>Power Steering Pump Replacement (Except 4.2L)</b>.</p> <p>Did you complete the replacement?</p>	-	Go to <b>Step 18</b>	-
14	<ol style="list-style-type: none"> <li>1. Remove the power steering pump flow control valve. Refer to <b>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</b>.</li> <li>2. Inspect the flow control valve.</li> </ol> <p>If any burrs or scratches are noticed on the flow control valve, replace the flow control valve. Do NOT attempt to clean the flow control valve. Refer to <b>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</b>.</p> <ol style="list-style-type: none"> <li>3. Inspect the flow control valve bore.</li> </ol>	-		

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	<p>If any burrs or scratches are present in the control valve bore, replace the power steering pump. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (Except 4.2L)</u></b>.</p> <p>Did you complete the repair?</p>		Go to <b>Step 18</b>	-
15	<p>Replace the power steering pump flow control valve. Refer to <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</u></b>.</p> <p>Did you complete the replacement?</p>	-	Go to <b>Step 18</b>	-
16	<ol style="list-style-type: none"> <li>1. Remove the power steering pump flow control valve and inspect for any wear or damage. Do NOT disassemble the flow control valve.</li> <li>2. If the flow control valve is worn damaged, replace the flow control valve. Refer to <b><u>Power Steering Pump Flow Control Valve Replacement - Off Vehicle (CB Series)</u></b>.</li> </ol> <p>Did you complete the repair?</p>	-	Go to <b>Step 18</b>	-
17	<p>The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to <b><u>Steering Gear Replacement</u></b>.</p> <p>Did you complete the replacement?</p>	-	Go to <b>Step 18</b>	-
18	<p>Test the power steering system for the original condition.</p> <p>Does the original condition still exist?</p>	-	Go to <b>Step 5</b>	Go to <b>Step 19</b>
19	<ol style="list-style-type: none"> <li>1. Disconnect and remove the <b>J 44721</b> from the vehicle. See <b><u>Special Tools</u></b>.</li> <li>2. Connect the vehicle power steering pipes/hoses.</li> <li>3. Bleed the power steering system and add fluid as necessary. Refer to <b><u>Power Steering System Bleeding</u></b>.</li> </ol> <p>Did you complete the repair?</p>	-	System OK	-

### POWER STEERING FLUID LEAKS

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Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b>Symptoms - Power Steering System</b>
2	Verify that power steering fluid leaks are present. Is the power steering system leaking?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering system fittings. Are the fittings leaking?	Go to <b>Step 8</b>	Go to <b>Step 4</b>
4	Inspect the power steering hoses. Are the hoses leaking?	Go to <b>Step 9</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump, shaft seal, and the reservoir for leaks. Is the power steering pump, shaft seal, or reservoir leaking?	Go to <b>Step 10</b>	Go to <b>Step 6</b>
6	Inspect the power steering gear for leaks. Is the power steering gear leaking?	Go to <b>Step 11</b>	Go to <b>Step 7</b>
7	Inspect the power steering cooler for leaks. Is the power steering cooler leaking?	Go to <b>Step 12</b>	Go to <b>Step 3</b>
8	Tighten the fittings. Refer to <b>Fastener Tightening Specifications</b> . Did you complete the repair?	Go to <b>Step 13</b>	-
9	Replace the power steering hoses. Refer to <b>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</b> or <b>Power Steering Gear Inlet and Outlet Hose Replacement (Except 4.2L)</b> . Did you complete the repair?	Go to <b>Step 13</b>	-
10	Replace the power steering pump or shaft seal. Refer to <b>Power Steering Pump Replacement (4.2L)</b> or <b>Power Steering Pump Replacement (Except 4.2L)</b> or <b>Power Steering Pump Shaft Seal Replacement (CB)</b> . Did you complete the repair?	Go to <b>Step 13</b>	-
11	Replace the power steering gear. Refer to <b>Steering Gear Replacement</b> . Did you complete the repair?	Go to <b>Step 13</b>	-
12	Replace the power steering cooler. Refer to <b>Power Steering Fluid Cooler Replacement (4.2L)</b> or <b>Power Steering Fluid Cooler Replacement (Except 4.2L)</b> . Did you complete the repair?	Go to <b>Step 13</b>	-
13	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (4.2L)

Step	Action	Yes	No
	Did you review the Power Steering System Description		Go to <b>Symptoms -</b>

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1	and perform the necessary inspections?	Go to <b>Step 2</b>	<b><u>Power Steering System</u></b>
2	Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of the power steering hoses incorrect?	Go to <b>Step 11</b>	Go to <b>Step 4</b>
4	Inspect the engine drive belt for cracking or excessive wear. Refer to <b><u>Drive Belt Falls Off and Excessive Wear Diagnosis</u></b> . Is the drive belt cracked or excessively worn?	Go to <b>Step 12</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to <b>Step 13</b>	Go to <b>Step 6</b>
6	Inspect the power steering pump and the power steering mounting bracket/brace for the proper installation. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (Except 4.2L)</u></b> . Is the power steering pump installation incorrect?	Go to <b>Step 14</b>	Go to <b>Step 7</b>
7	Inspect the power steering gear for the proper installation. Refer to <b><u>Steering Gear Replacement</u></b> . Is the power steering gear installation incorrect?	Go to <b>Step 15</b>	Go to <b>Step 8</b>
8	Inspect the power steering gear rack bearing preload for the proper adjustment. Is the power steering gear rack bearing preload adjustment incorrect?	Go to <b>Step 16</b>	Go to <b>Step 9</b>
9	Inspect the suspension. Is the suspension worn?	Go to <b>Step 17</b>	Go to <b>Step 10</b>
10	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to <b>Step 18</b>	Go to <b>Step 3</b>
11	Adjust or replace the power steering hoses. Refer to <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</u></b> or <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (Except 4.2L)</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
12	Replace the engine drive belt. Refer to <b><u>Drive Belt Tensioner Replacement</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
13	Replace the power steering pump pulley. Refer to <b><u>Power Steering Pump Pulley Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Pulley Replacement (Except 4.2L)</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
	Install the power steering pump correctly. Refer to		

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14	<b><u>Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (Except 4.2L).</u></b> Did you complete the repair?	Go to <b>Step 19</b>	-
15	Install the power steering gear correctly. Refer to <b><u>Steering Gear Replacement.</u></b> Did you complete the repair?	Go to <b>Step 19</b>	-
16	Adjust the power steering gear rack bearing preload. Did you complete the repair?	Go to <b>Step 19</b>	-
17	Replace the worn suspension components. Refer to <b><u>Diagnostic Starting Point - Suspension General Diagnosis .</u></b> Did you complete the repair?	Go to <b>Step 19</b>	-
18	Replace the intermediate shaft. Refer to <b><u>Upper Intermediate Steering Shaft Replacement</u></b> or <b><u>Lower Intermediate Steering Shaft Replacement .</u></b> Did you complete the repair?	Go to <b>Step 19</b>	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### **RATTLE, CLUNK, OR SHUDDER NOISE FROM THE POWER STEERING SYSTEM (EXCEPT 4.2L)**

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that a rattle, clunk, or shudder noise is present. Is a rattle, clunk, or shudder noise present?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of the power steering hoses incorrect?	Go to <b>Step 11</b>	Go to <b>Step 4</b>
4	Inspect the engine drive belt for cracking or excessive wear. Refer to Drive Belt Falls Off and Excessive Wear Diagnosis . Is the drive belt cracked or excessively worn?	Go to <b>Step 12</b>	Go to <b>Step 5</b>
5	Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged?	Go to <b>Step 13</b>	Go to <b>Step 6</b>
6	Inspect the power steering pump and the power steering mounting bracket/brace for the proper installation. Refer to <b><u>Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (Except 4.2L).</u></b> Is the power steering pump installation incorrect?	Go to <b>Step 14</b>	Go to <b>Step 7</b>
	Inspect the power steering gear for the proper		

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7	installation. Refer to <b><u>Steering Gear Replacement</u></b> . Is the power steering gear installation incorrect?	Go to <b>Step 15</b>	Go to <b>Step 8</b>
8	Inspect the power steering gear rack bearing preload for the proper adjustment. Is the power steering gear rack bearing preload adjustment incorrect?	Go to <b>Step 16</b>	Go to <b>Step 9</b>
9	Inspect the suspension. Is the suspension worn?	Go to <b>Step 17</b>	Go to <b>Step 10</b>
10	Inspect the intermediate shaft. Is the intermediate shaft worn?	Go to <b>Step 18</b>	Go to <b>Step 3</b>
11	Adjust or replace the power steering hoses. Refer to <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (4.2L)</u></b> or <b><u>Power Steering Gear Inlet and Outlet Hose Replacement (Except 4.2L)</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
12	Replace the engine drive belt. Refer to Drive Belt Replacement - Accessory . Did you complete the repair?	Go to <b>Step 19</b>	-
13	Replace the power steering pump pulley. Refer to <b><u>Power Steering Pump Pulley Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Pulley Replacement (Except 4.2L)</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
14	Install the power steering pump correctly. Refer to <b><u>Power Steering Pump Replacement (4.2L)</u></b> or <b><u>Power Steering Pump Replacement (Except 4.2L)</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
15	Install the power steering gear correctly. Refer to <b><u>Steering Gear Replacement</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
16	Adjust the power steering gear rack bearing preload. Did you complete the repair?	Go to <b>Step 19</b>	-
17	Replace the worn suspension components. Refer to <b><u>Diagnostic Starting Point - Suspension General Diagnosis</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
18	Replace the intermediate shaft. Refer to <b><u>Upper Intermediate Steering Shaft Replacement</u></b> or <b><u>Lower Intermediate Steering Shaft Replacement</u></b> . Did you complete the repair?	Go to <b>Step 19</b>	-
19	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### WHINE OR GROWL NOISE FROM THE POWER STEERING SYSTEM

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Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b>Symptoms - Power Steering System</b>
2	Verify that a whine or growl noise is present. Is a whine or growl noise present?	Go to <b>Step 3</b>	System OK
3	Inspect the power steering fluid for the following indications of contamination: <ul style="list-style-type: none"> <li>• Milky fluid - water</li> <li>• Brown Fluid - burnt</li> <li>• Debris in fluid - plastic or dirt</li> </ul> Is the fluid free of contamination?	Go to <b>Step 5</b>	Go to <b>Step 4</b>
4	Flush the power steering system. Refer to <b>Power Steering System Bleeding</b> . Did you complete the procedure?	Go to <b>Step 11</b>	Go to <b>Step 5</b>
5	Using the <b>J 39570</b> Chassis Ear, inspect the power steering gear for a whine or growl noise. Is the noise present at the power steering gear?	Go to <b>Step 8</b>	Go to <b>Step 6</b>
6	Using the <b>J 39570</b> , inspect the power steering pump for a whine or growl noise. Is the noise present at the power steering pump?	Go to <b>Step 9</b>	Go to <b>Step 7</b>
7	Using the <b>J 39570</b> , inspect the power steering hoses for a whine or growl noise. Is the noise present at the power steering hoses?	Go to <b>Step 10</b>	Go to <b>Step 2</b>
8	Replace the power steering gear. Refer to <b>Steering Gear Replacement</b> . Did you complete the repair?	Go to <b>Step 11</b>	-
9	Replace the power steering pump. Refer to <b>Power Steering Pump Replacement (4.2L)</b> or <b>Power Steering Pump Replacement (Except 4.2L)</b> . Did you complete the repair?	Go to <b>Step 11</b>	-
10	Adjust the routing of the power steering hoses. Did you complete the repair?	Go to <b>Step 11</b>	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### POOR RETURN OF STEERING WHEEL

#### Poor Return of Steering Wheel

Step	Action	Yes	No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to			



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center.

1	Did you review the General Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Power Steering System Description and Operation (w/o Electro-Hydraulic Steering)</u></b>
2	Verify that poor return of the steering wheel is present. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	<ol style="list-style-type: none"> <li>1. Raise and support the vehicle. Refer to <b><u>Lifting and Jacking the Vehicle</u></b> .</li> <li>2. Lubricate the tie rod ends and ball joints, if applicable.</li> <li>3. Inspect the suspension system for worn or damaged components.</li> <li>4. Repair as necessary.</li> </ol> <p>Did you find and correct the condition?</p>	Go to <b>Step 12</b>	Go to <b>Step 4</b>
4	<ol style="list-style-type: none"> <li>1. Rotate the steering wheel ONE revolution in both directions.</li> <li>2. Rotate the steering wheel back to the original position.</li> </ol> <p>Was the steering wheel abnormally difficult to rotate in either direction?</p>	Go to <b>Step 5</b>	Go to <b>Step 10</b>
5	<p><b>IMPORTANT:</b> Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center.</p> <ol style="list-style-type: none"> <li>1. Disconnect the intermediate shaft from the steering column.</li> <li>2. Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions.</li> <li>3. Rotate the steering wheel back to the original position.</li> </ol> <p>Was the steering wheel abnormally difficult to rotate in either direction?</p>	Go to <b>Step 11</b>	Go to <b>Step 6</b>
6	Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Did you find and complete the repair?	Go to <b>Step 12</b>	Go to <b>Step 7</b>

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7	<ol style="list-style-type: none"> <li>1. Remove the front tire and wheel assemblies. Refer to <b><u>Tire and Wheel Removal and Installation</u></b> .</li> <li>2. Disconnect both outer tie rod ends from the steering knuckles.</li> <li>3. Use your hands in order to move the tie rod end studs.</li> <li>4. If abnormally difficult to move, replace the tie rod end. If equipped with recirculating ball steering, ensure that idler and pitman arm joints are not too stiff. Repair as necessary.</li> </ol>		
	Did you find and complete the repair?	Go to <b>Step 12</b>	Go to <b>Step 8</b>
8	<ol style="list-style-type: none"> <li>1. Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle.</li> <li>2. Repair or replace any abnormally stiff or loose components.</li> </ol>		
	Did you find and complete the repair?	Go to <b>Step 12</b>	Go to <b>Step 9</b>
9	Inspect for binding in the steering gear. If a binding is present repair or replace the steering gear. Did you find and complete the repair?	Go to <b>Step 12</b>	Go to <b>Step 10</b>
10	Inspect the wheel alignment and adjust as necessary. Refer to <b><u>Wheel Alignment Measurement</u></b> . Did you find and complete the repair?	Go to <b>Step 12</b>	-
11	Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Did you find and complete the repair?	Go to <b>Step 12</b>	-
12	Operate the system in order to verify the repair. Did you correct the condition?	System OK	-

### STEERING EFFORT TOO EASY IN ONE OR BOTH DIRECTIONS

Step	Action	Yes	No
1	Did you review the Power Steering System Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that the steering effort is too easy in one or both directions. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Perform the power steering test procedure. Refer to <b><u>Power Steering System Test</u></b> .		

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	Did you complete the procedure?	Go to <b>Step 4</b>	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

### STEERING EFFORT HARD IN ONE OR BOTH DIRECTIONS

Step	Action	Yes	No
1	Did you review the Power Steering System General Description and perform the necessary inspections?	Go to <b>Step 2</b>	Go to <b><u>Symptoms - Power Steering System</u></b>
2	Verify that the steering effort is hard in one or both directions. Does the system operate normally?	System OK	Go to <b>Step 3</b>
3	Perform the power steering test procedure. Refer to <b><u>Power Steering System Test</u></b> . Did you complete the procedure?	Go to <b>Step 4</b>	-
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to <b>Step 3</b>

## REPAIR INSTRUCTIONS

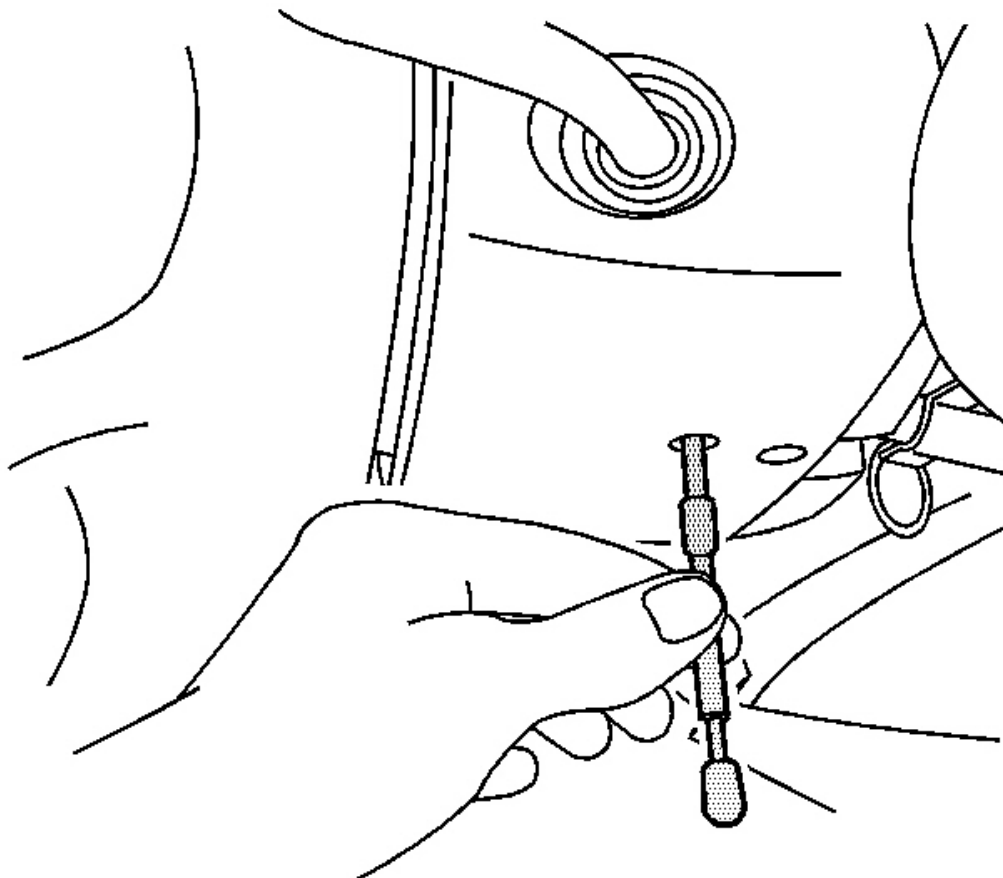
### RACK & PINION STEERING LINKAGE INSPECTION

#### Tools Required

- **J 8001** Dial Indicator Set
- **J 42640** Steering Column Anti-Rotation Pin

#### Outer Tie Rod

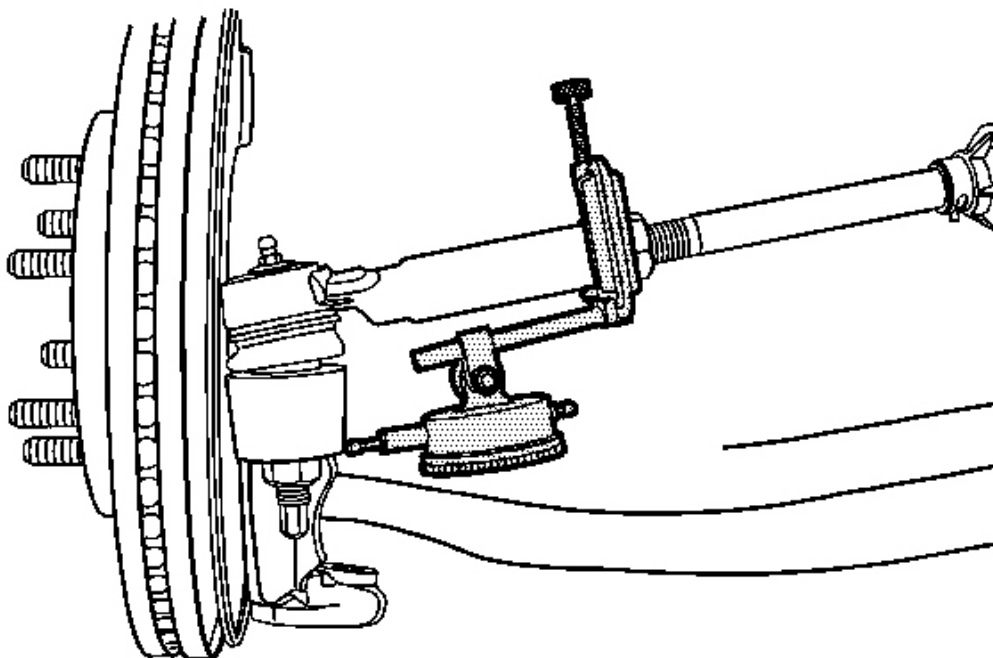
1. Inspect the outer tie rod end seal. If the outer tie rod end seal is torn, replace the outer tie rod end. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.



**Fig. 4: Identifying J 42640**

**Courtesy of GENERAL MOTORS CORP.**

2. Position the wheels in a straight-ahead position and install the anti-rotation pin **J 42640** .
3. Elevate the left or right front of the vehicle and install a suitable vehicle support, maintaining contact between one front wheel and the shop floor. Refer to **Lifting and Jacking the Vehicle** .



**Fig. 5: Checking Tie Rod-To-Steering Knuckle Lash**  
Courtesy of GENERAL MOTORS CORP.

4. Install dial indicator **J 8001** , or equivalent between the outer tie rod end and steering knuckle as shown. Push slowly inward with one hand on the tire to remove the lash.

In the graphic above, the wheel and tire are removed for clarity.

5. Place the dial indicator at zero, pull outward on the tire. Record the amount of movement in the joint.

Movement should not exceed 1.0 mm (0.04 in). If movement exceeds 1.0 mm (0.04 in) replace the outer tie rod end. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

6. Repeat this procedure for the other side of the vehicle.

## **POWER STEERING SYSTEM BLEEDING**

### **IMPORTANT:**

- Use clean, new power steering fluid type only. See the Maintenance and Lubrication subsection for fluid specifications. Refer to **Fluid and Lubricant Recommendations** .

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- Hoses touching the frame, body or engine may cause system noise. Verify that the hoses do not touch any other part of the vehicle.
- Loose connections may not leak, but could allow air into the steering system. Verify that all hose connections are tight.

**IMPORTANT: Power steering fluid level must be maintained throughout bleed procedure.**

1. Fill pump reservoir with fluid to minimum system level, FULL COLD level, or middle of hash mark on cap stick fluid level indicator.

**IMPORTANT: With hydro-boost only, the oil level will appear falsely high if the hydro-boost accumulator is not fully charged. Do not apply the brake pedal with the engine OFF. This will discharge the hydro-boost accumulator.**

2. If equipped with hydro-boost, fully charge the hydro-boost accumulator using the following procedure:
  1. Start the engine.
  2. Firmly apply the brake pedal 10-15 times.
  3. Turn the engine OFF.
3. Raise the vehicle until the front wheels are off the ground. Refer to **Lifting and Jacking the Vehicle**.
4. Key on engine OFF, turn the steering wheel from stop to stop 12 times.

Vehicles equipped with hydro-boost systems or longer length power steering hoses may require turns up to 15 to 20 stop to stops.

5. Verify power steering fluid level per operating specification. Refer to **Checking and Adding Power Steering Fluid**.
6. Start the engine. Rotate steering wheel from left to right. Check for sign of cavitation or fluid aeration (pump noise/whining).
7. Verify the fluid level. Repeat the bleed procedure, if necessary.

### CHECKING & ADDING POWER STEERING FLUID

**NOTE:** When adding fluid or making a complete fluid change, always use the proper power steering fluid. Failure to use the proper fluid will cause hose and seal damage and fluid leaks.

1. Clean the area surrounding the reservoir cap.
2. Remove the reservoir cap.
3. Inspect the power steering pump fluid level at regular intervals. Use the appropriate procedure below.

Add fluid when required. Refer to **Fluid and Lubricant Recommendations**.

**Fluid Is Hot**

1. Run the engine until the fluid reaches about 80°C (170°F).
2. Turn the engine OFF.
3. Remove the reservoir cap.
4. Inspect the fluid level on the capstick.
5. Ensure that the fluid level is at the HOT/FULL mark on the capstick.
4. If the fluid level is low, add power steering fluid to the proper level.
5. Install the reservoir cap.
6. When checking the fluid level after servicing the steering system, bleed the air from the system. Refer to **Power Steering System Bleeding**.

**POWER STEERING SYSTEM FLUSHING**

**IMPORTANT: Do not reuse any drained power steering fluid regardless of appearance or condition.**

1. Turn OFF the engine.
2. Raise the front end of the vehicle off the ground until the tires and wheels turn freely. Refer to **Lifting and Jacking the Vehicle**.
3. Place a large container under the fluid return hose in order to collect the draining fluid.
4. Remove the fluid return hose at the power steering pump reservoir inlet connection.
5. Plug the reservoir return hose inlet connection on the power steering pump.

**IMPORTANT: This step may require 4 L (4 qt) of power steering fluid until the draining fluid appears clear.**

6. With the key on engine off, turn the steering wheel fully to the left and to the right while an assistant maintains the minimum fluid level in the reservoir using new approved power steering fluid. Continue until the fluid from the return hose runs clear.
7. Remove the plug from the pump reservoir inlet connection and install the fluid return hose to the pump reservoir.

**IMPORTANT: Do NOT run the engine without the power steering fluid at a minimum system level.**

8. Bleed the power steering system. Refer to **Power Steering System Bleeding**.
9. Inspect the power steering fluid for the following indications of contamination:
  - Milky fluid - water
  - Brown fluid - burnt
  - Plastic debris or dirt chunks

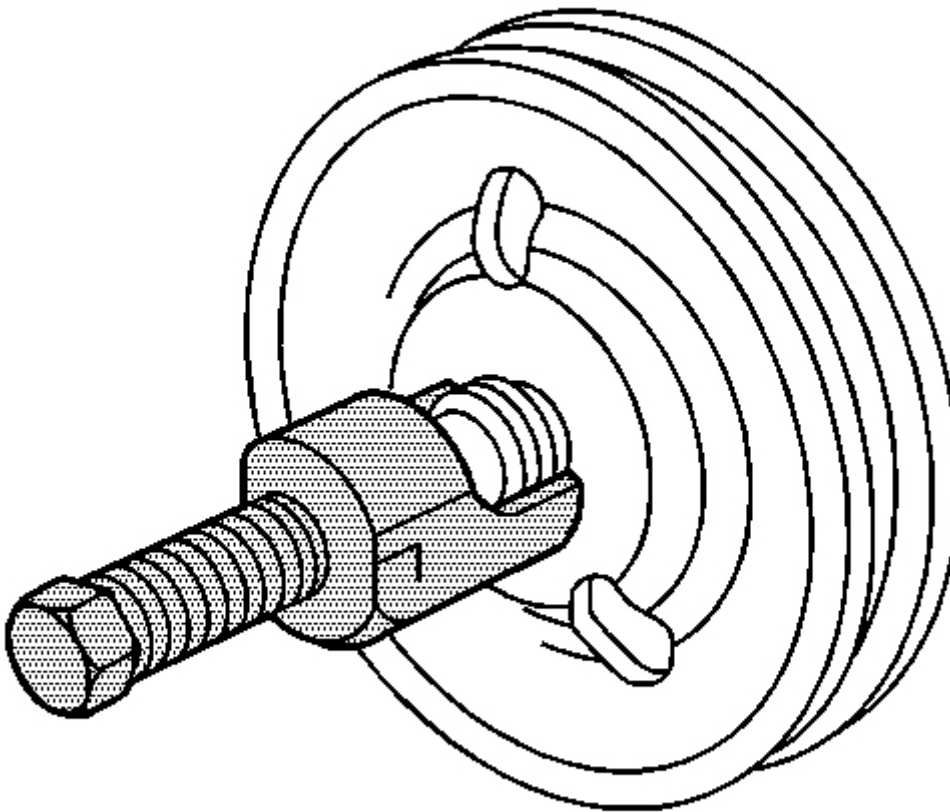
10. If the fluid is contaminated, repeat steps 2-9.
11. Lower the vehicle and check the Power Steering system for leaks.

## **POWER STEERING PUMP PULLEY REPLACEMENT (4.2L)**

### **Tools Required**

- **J 25033-C** Power Steering Pump Pulley Installer. See **Special Tools**.
- **J 25034-C** Power Steering Pump Pulley Remover. See **Special Tools**.

### **Removal Procedure**

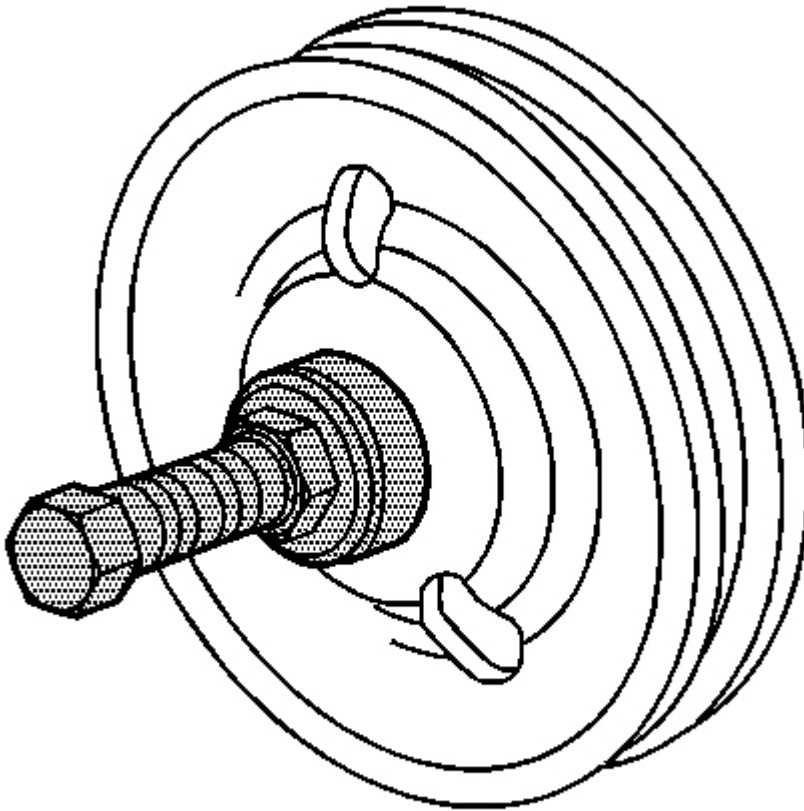


**Fig. 6: View Of Power Steering Pump Pulley Remover**  
Courtesy of GENERAL MOTORS CORP.



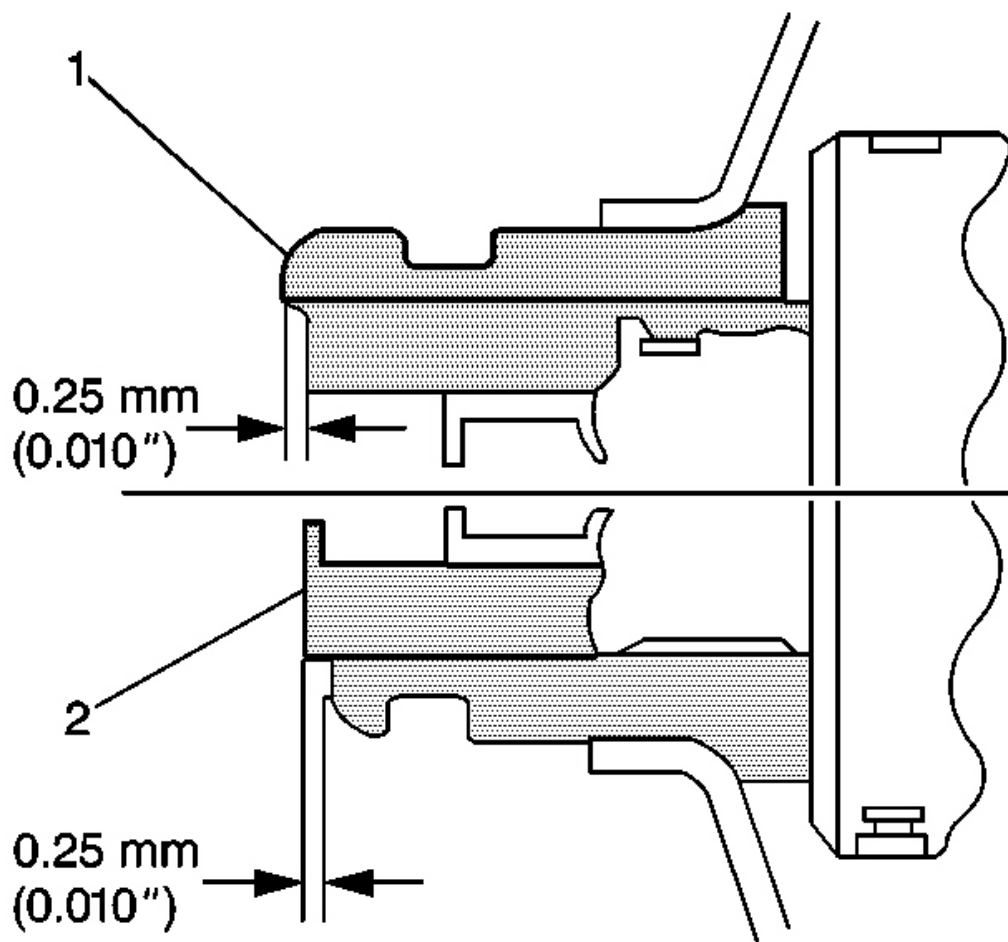
1. Remove the drive belt. Refer to **Drive Belt Replacement** .
2. Remove the power steering pump pulley using **J 25034-C** . See **Special Tools**.

**Installation Procedure**



**Fig. 7: View Of Power Steering Pump Pulley Installer**  
Courtesy of GENERAL MOTORS CORP.

1. Install the power steering pump pulley to the end of the power steering pump shaft.
2. Install the power steering pump pulley to the power steering pump using **J 25033-C** . See **Special Tools**.



**Fig. 8: Checking Power Steering Pump Pulley Installed Depth**  
Courtesy of GENERAL MOTORS CORP.

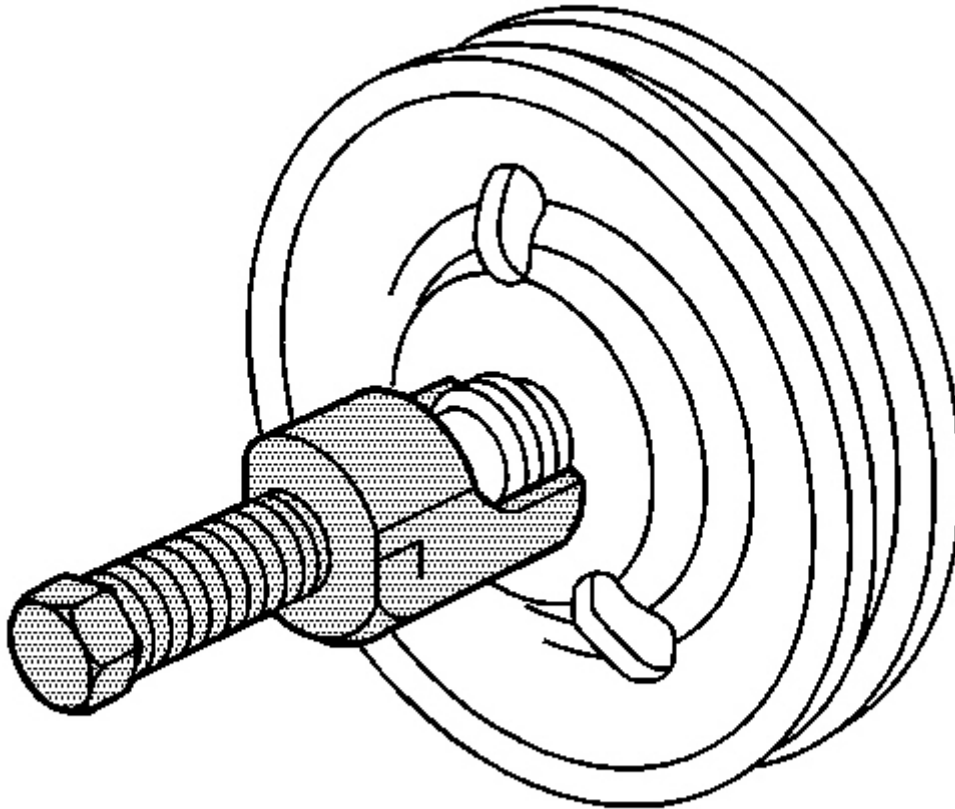
3. Install the power steering pump pulley (1) flush against the end of the power steering pump shaft (2), with an allowable variance of 0.25 mm (0.01 in).
4. Install the drive belt. Refer to **Drive Belt Replacement** .

#### **POWER STEERING PUMP PULLEY REPLACEMENT (EXCEPT 4.2L)**

##### **Tools Required**

- **J 25033-C** Power Steering Pump Pulley Installer. See **Special Tools**.
- **J 25034-C** Power Steering Pump Pulley Remover. See **Special Tools**.

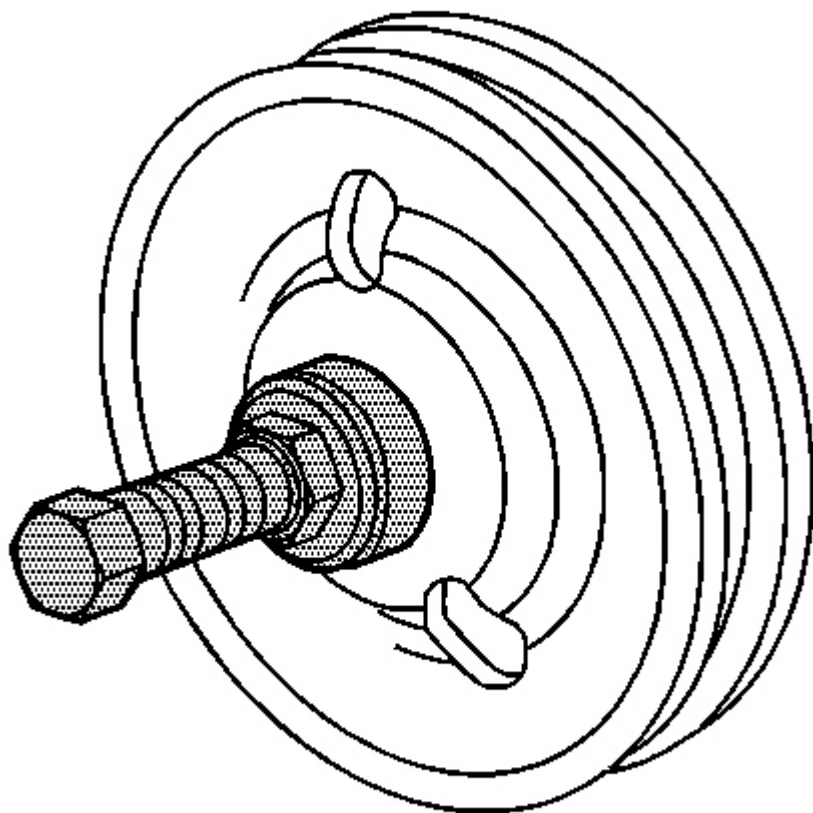
## Removal Procedure



**Fig. 9: View Of Power Steering Pump Pulley Remover**  
Courtesy of GENERAL MOTORS CORP.

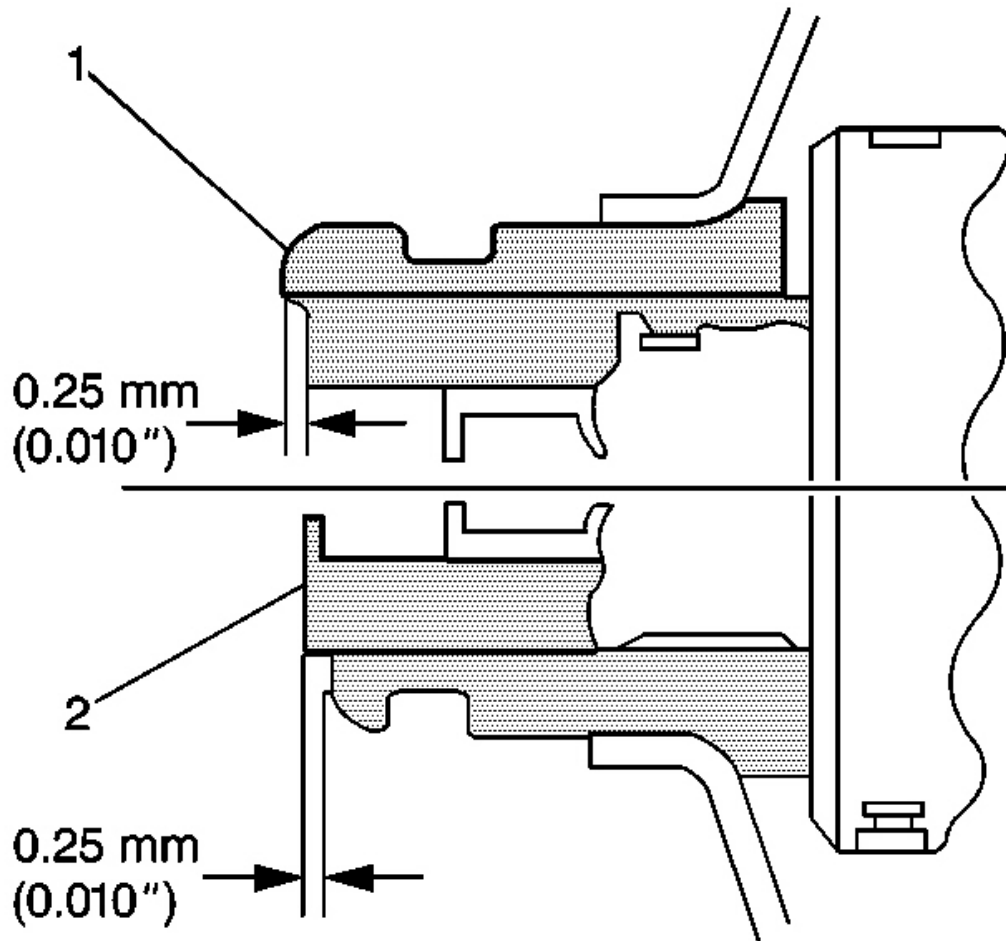
1. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)**.
2. Secure the power steering pump in a vise, taking care not to damage the power steering reservoir.
3. Using the **J 25034-C** , remove the power steering pump pulley. See **Special Tools**.

## Installation Procedure



**Fig. 10: View Of Power Steering Pump Pulley Installer**  
Courtesy of GENERAL MOTORS CORP.

1. Position the power steering pump pulley to the end of the power steering pump shaft.
2. Using the **J 25033-C** , install the power steering pump pulley to the power steering pump. See **Special Tools**.

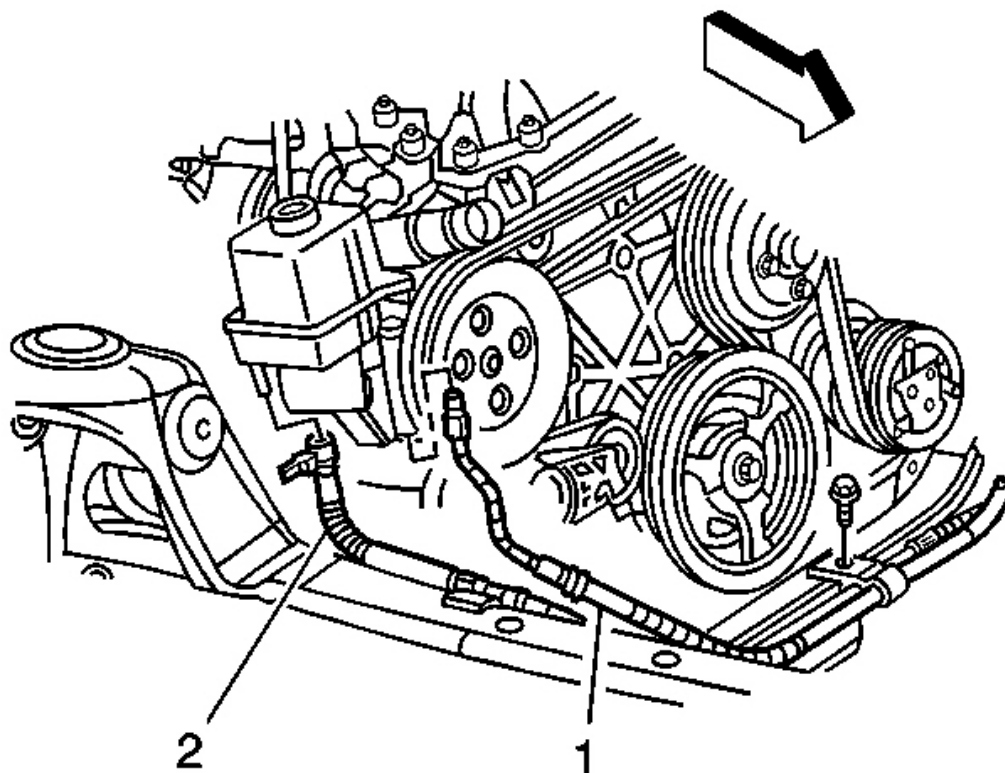


**Fig. 11: Checking Power Steering Pump Pulley Installed Depth**  
Courtesy of GENERAL MOTORS CORP.

3. Install the power steering pump pulley (1) flush against the end of the power steering pump shaft (2), with an allowable variance of 0.25 mm (0.010 in).
4. Install the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)**.

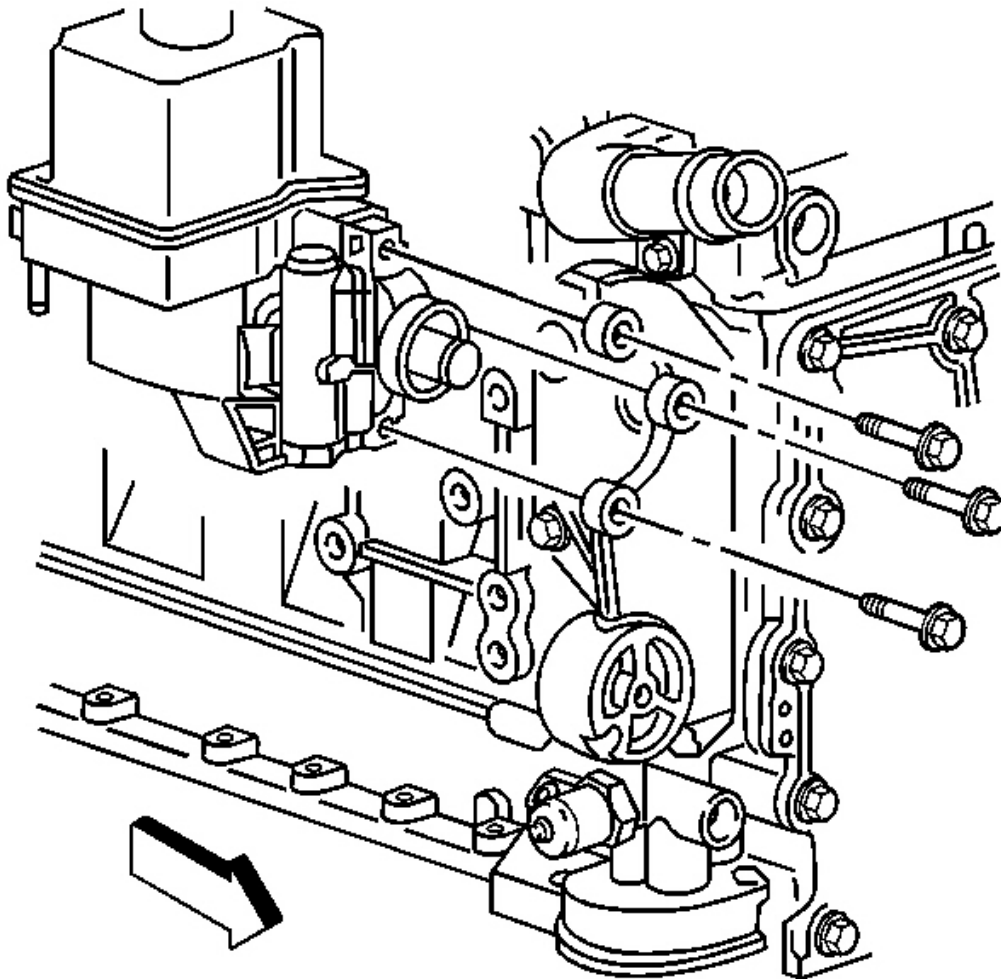
## **POWER STEERING PUMP REPLACEMENT (4.2L)**

### **Removal Procedure**



**Fig. 12: Identifying Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
2. Remove the drive belt. Refer to **Drive Belt Replacement** .
3. Install a drain pan under the vehicle.
4. Disconnect the power steering pressure hose (1) from the power steering pump.
5. Disconnect the power steering cooler hose (2) from the power steering pump.
6. Disconnect the wiring harness from the wiring loom on the power steering pump.

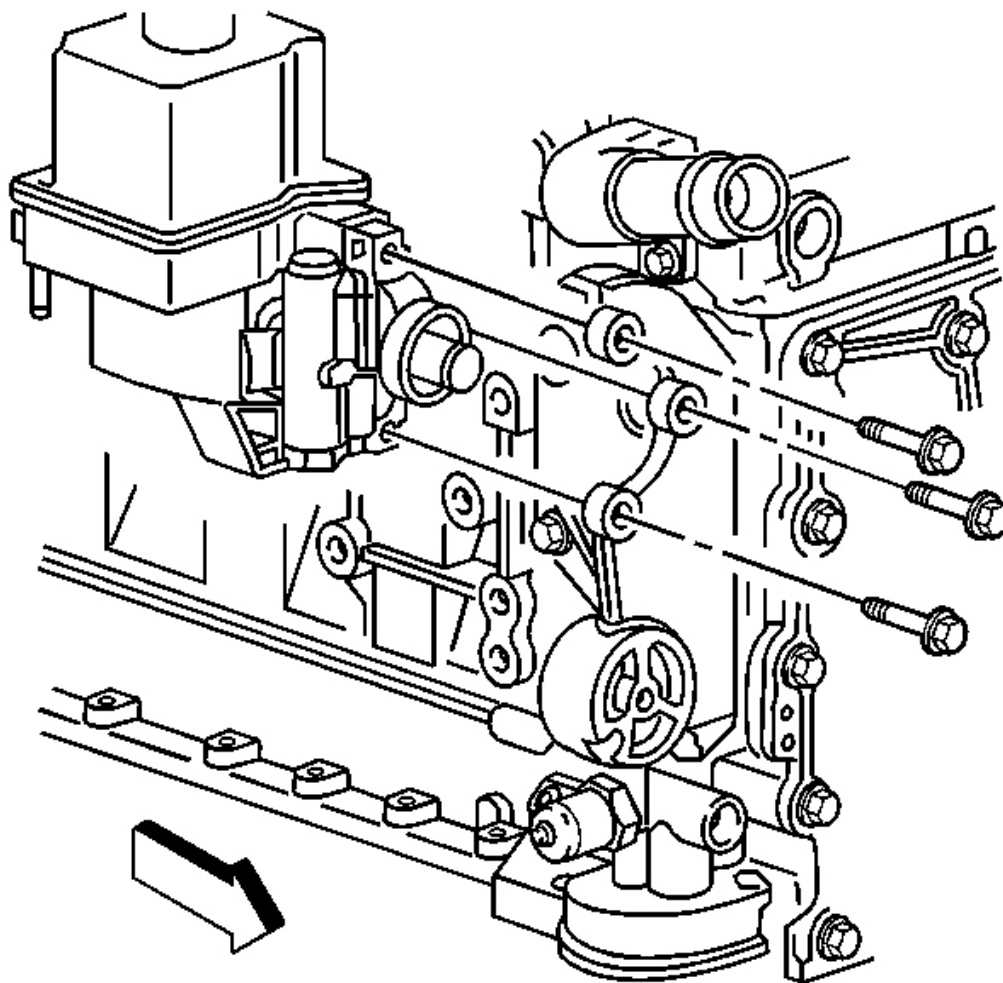


**Fig. 13: View Of Power Steering Pump Bolts**  
Courtesy of GENERAL MOTORS CORP.

7. Remove the power steering pump mounting bolts.
8. Remove the power steering pump.
9. Remove the power steering pump pulley. Refer to **Power Steering Pump Pulley Replacement (4.2L)** or **Power Steering Pump Pulley Replacement (Except 4.2L)**.

#### Installation Procedure

1. Install the power steering pump pulley. Refer to **Power Steering Pump Pulley Replacement (4.2L)** or **Power Steering Pump Pulley Replacement (Except 4.2L)**.



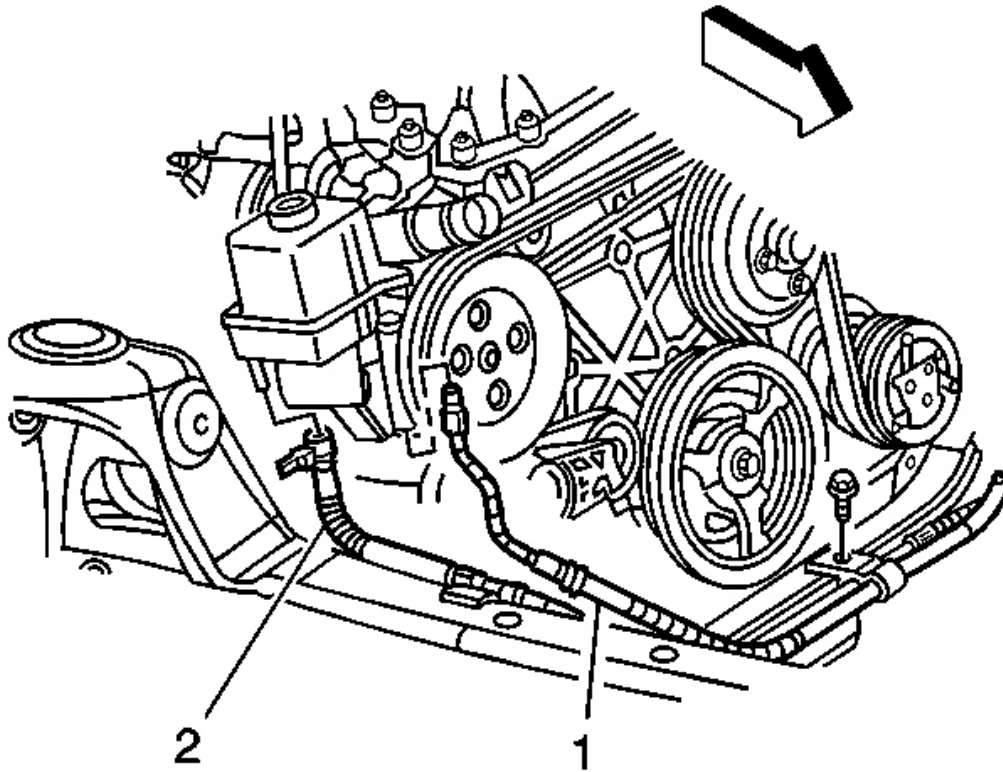
**Fig. 14: View Of Power Steering Pump Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to Fastener Notice .

2. Install the power steering pump.
3. Install the power steering pump mounting bolts.

**Tighten:** Tighten the power steering pump mounting bolts to 25 N.m (18 lb ft).





**Fig. 15: Identifying Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

4. Install the power steering cooler hose (2) to the power steering pump.
5. Install the power steering pressure hose (1) to the power steering pump.

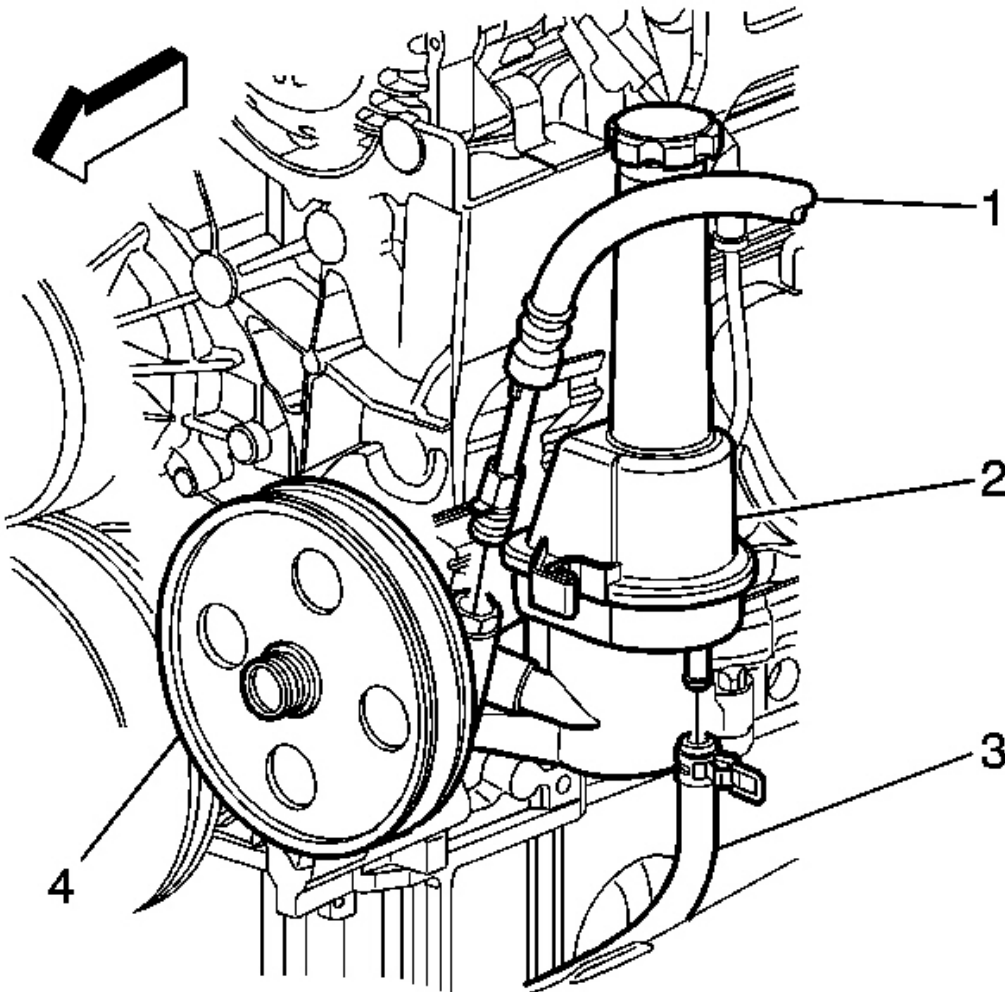
**Tighten:** Tighten the power steering pressure hose to 25 N.m (18 lb ft).

6. Remove the drain pan from under the vehicle.
7. Install the drive belt. Refer to **Drive Belt Replacement** .
8. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
9. Bleed the power steering system. Refer to **Power Steering System Bleeding**.
10. Inspect the power steering system for leaks and the hoses for clearance away from the frame and other components.

## **POWER STEERING PUMP REPLACEMENT (EXCEPT 4.2L)**

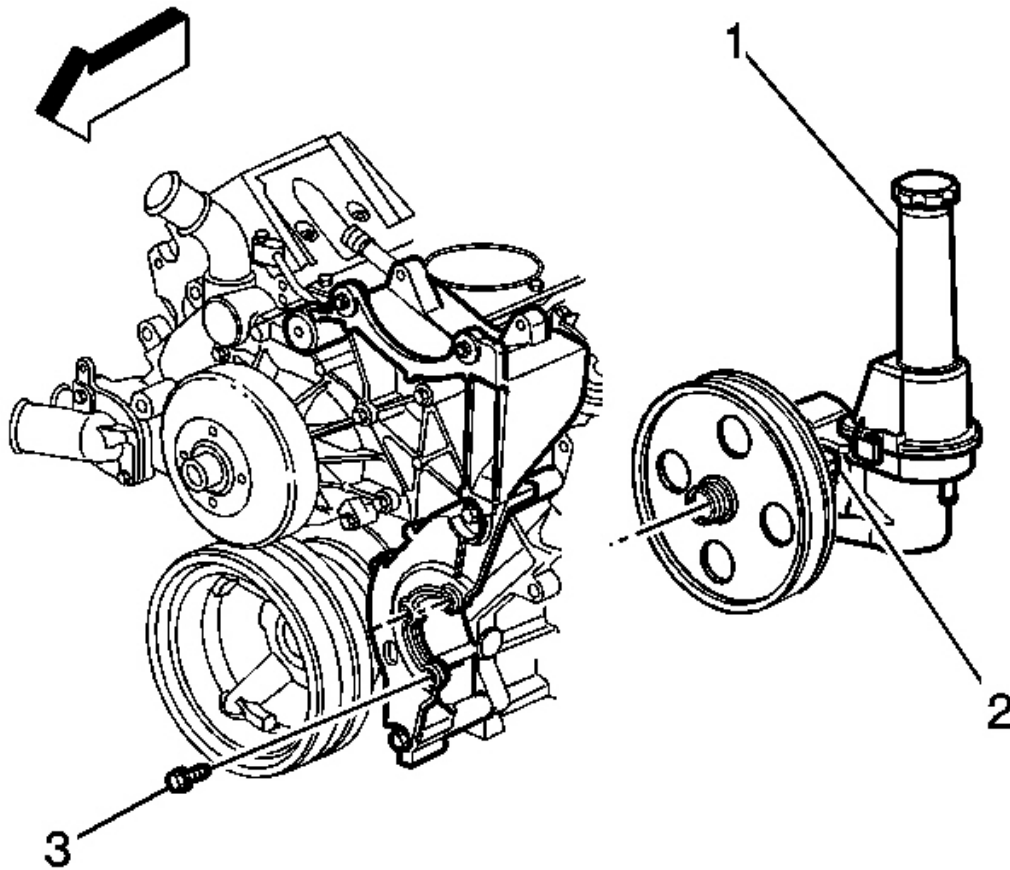
**Removal Procedure**

1. Remove the drive belt. Refer to Drive Belt Replacement - Accessory .
2. Remove the engine control module (ECM) from the ECM mounting bracket and move to the side. Refer to Engine Control Module Replacement .



**Fig. 16: View Of Power Steering Pressure Hose, Return Hose & Pump**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove the power steering pressure hose (1) from power steering pump (2).
4. Remove the power steering pump return hose (3) from power steering pump (2).



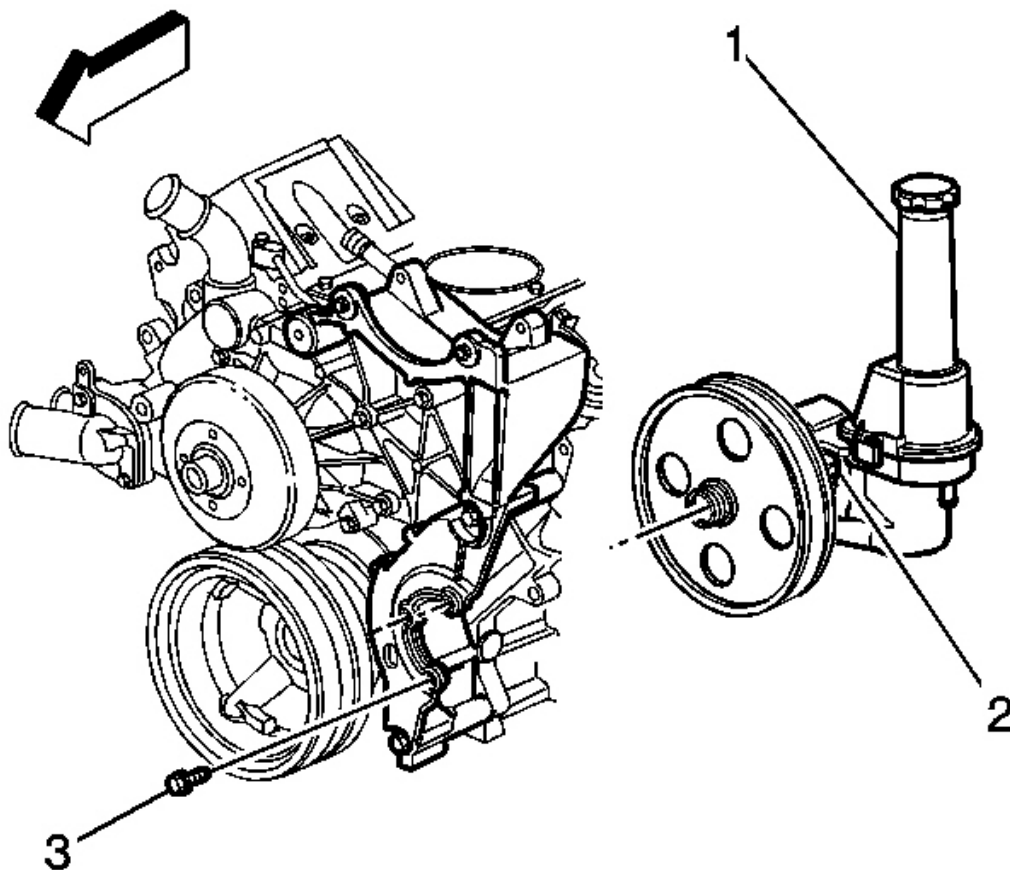
**Fig. 17: View Of Power Steering Pump & Bolts**  
Courtesy of GENERAL MOTORS CORP.

5. Remove the power steering pump mounting bolts (3).
6. Remove the power steering pump (1).
7. Remove the power steering pump pulley. Refer to **Power Steering Pump Pulley Replacement (4.2L)** or **Power Steering Pump Pulley Replacement (Except 4.2L)**.
8. If applicable, remove the power steering pump reservoir. Refer to **Power Steering Fluid Reservoir Replacement - Off Vehicle (CB Series)**.

#### Installation Procedure

1. If applicable, install the power steering pump reservoir. Refer to **Power Steering Fluid Reservoir Replacement - Off Vehicle (CB Series)**.
2. Install the power steering pump pulley. Refer to **Power Steering Pump Pulley Replacement (4.2L)** or

**Power Steering Pump Pulley Replacement (Except 4.2L).**



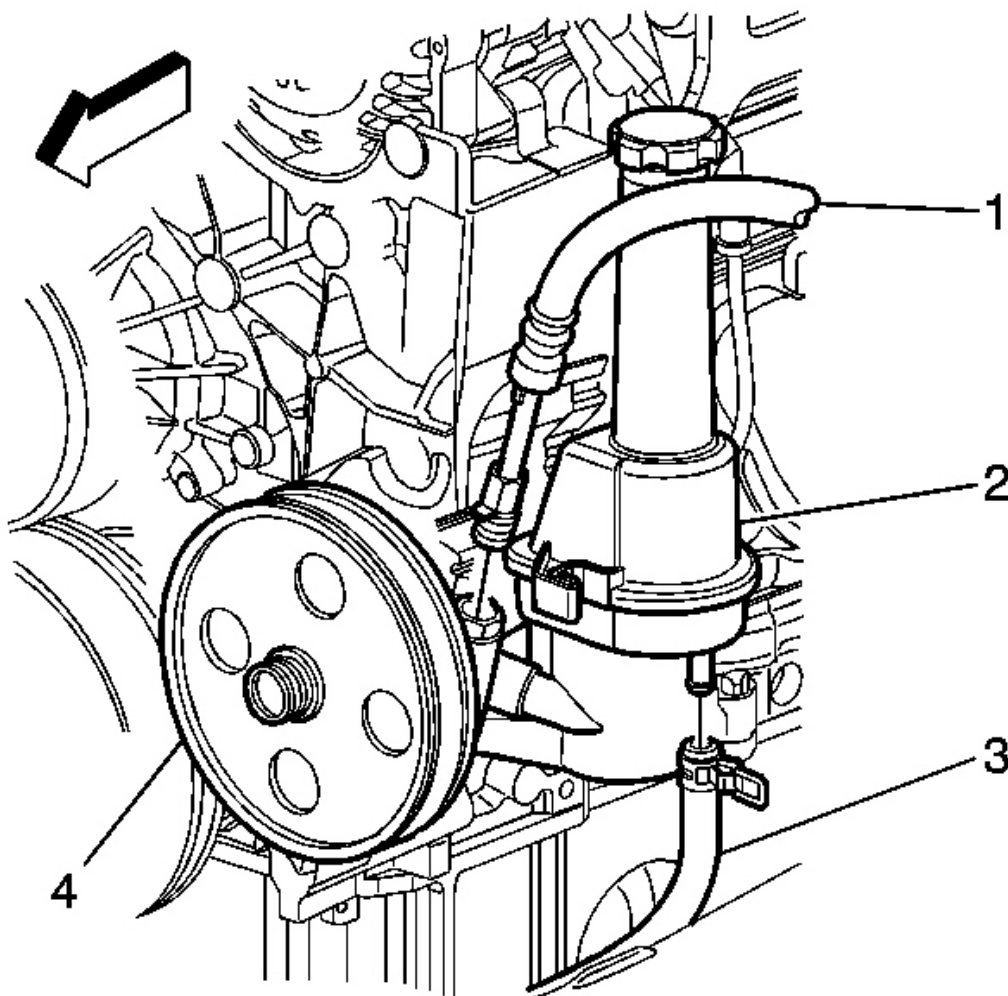
**Fig. 18: View Of Power Steering Pump & Bolts**  
Courtesy of GENERAL MOTORS CORP.

3. Align the power steering pump (1) with mounting bolt holes on engine block (2).

**NOTE:** Refer to Fastener Notice .

4. Install the power steering pump mounting bolts (3).

**Tighten:** Tighten the bolts to 25 N.m (18 lb ft).



**Fig. 19: View Of Power Steering Pressure Hose, Return Hose & Pump**  
Courtesy of GENERAL MOTORS CORP.

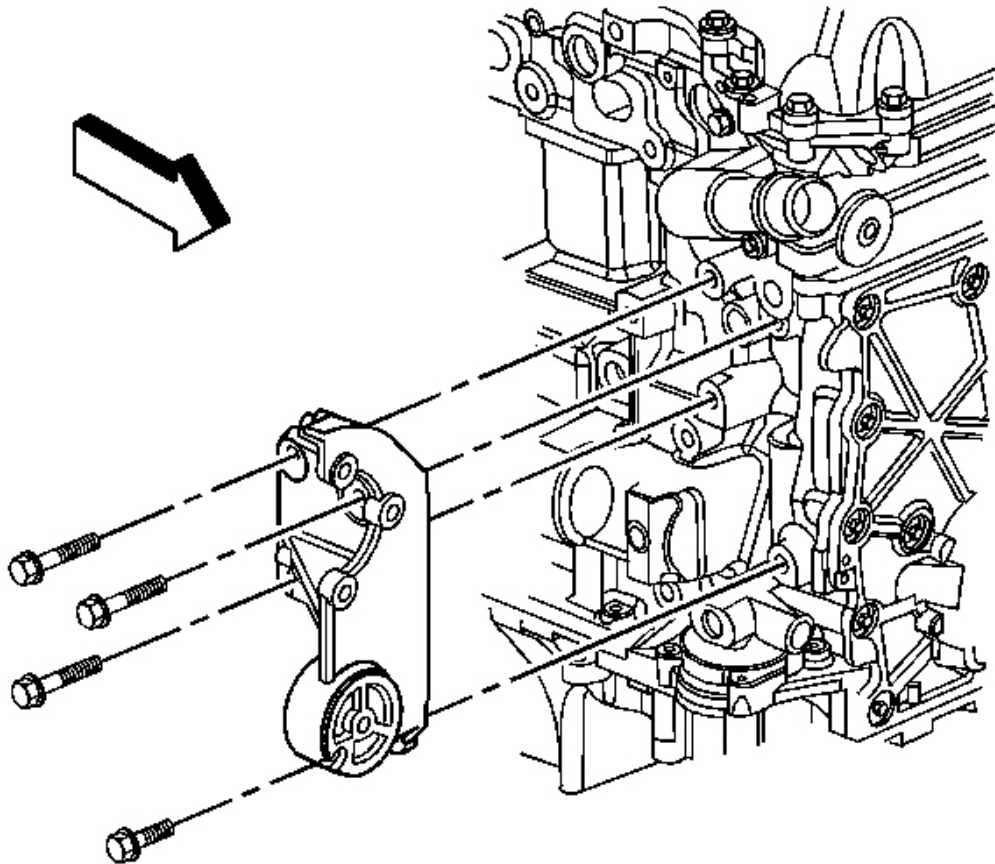
5. Attach the power steering pump return hose (3) to power steering pump (2).
6. Attach the power steering pump pressure hose (1) to power steering pump (2).

**Tighten:** Tighten the fittings to 25 N.m (18 lb ft).

7. Install the ECM to the ECM mounting bracket. Refer to Engine Control Module Replacement .
8. Install the drive belt. Refer to Drive Belt Replacement - Accessory .
9. Bleed the power steering system. Refer to **Power Steering System Bleeding**.

## **POWER STEERING PUMP BRACKET REPLACEMENT**

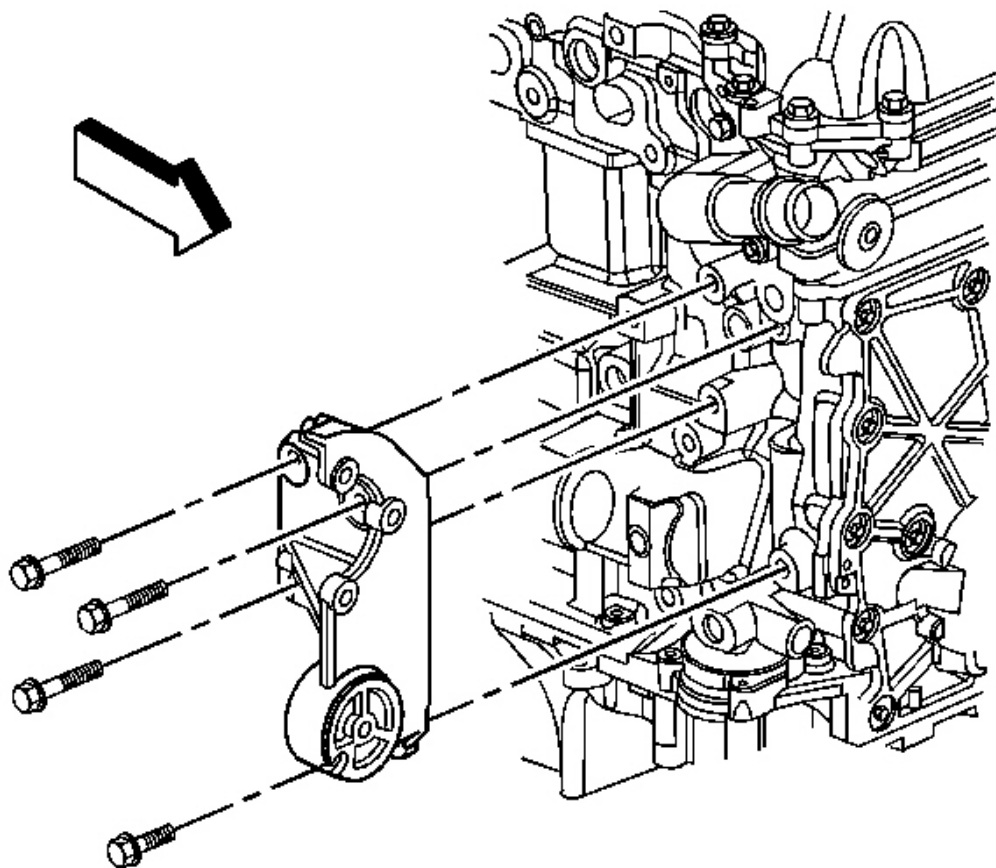
### **Removal Procedure**



**Fig. 20: View Of Power Steering Pump Bracket & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the power steering pump. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)**.
2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement** .
3. Remove the power steering pump bracket mounting bolts.
4. Remove the power steering pump bracket.

### **Installation Procedure**



**Fig. 21: View Of Power Steering Pump Bracket & Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

1. Install the power steering pump bracket.

**NOTE:** Refer to Fastener Notice .

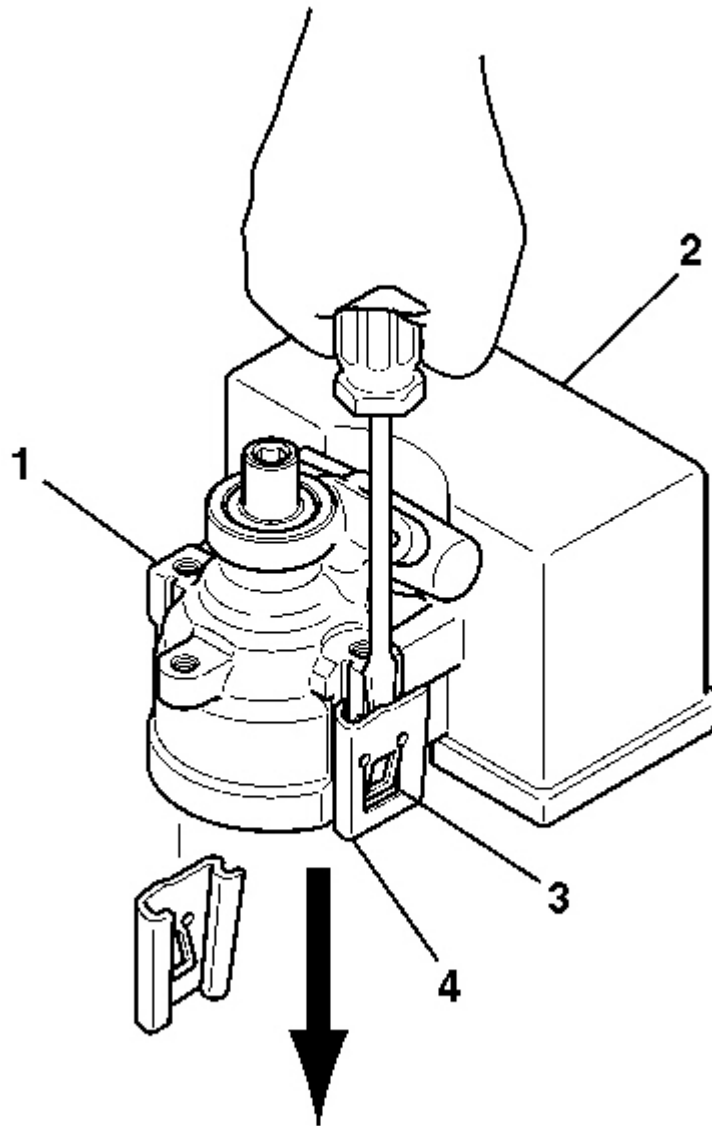
2. Install the power steering pump bracket mounting bolts.

**Tighten:** Tighten the power steering pump mounting bolts to 50 N.m (37 lb ft).

3. Install the drive belt tensioner. Refer to Drive Belt Tensioner Replacement .
4. Install the power steering pump. Refer to Power Steering Pump Replacement (4.2L) or Power Steering Pump Replacement (Except 4.2L).

## **POWER STEERING FLUID RESERVOIR REPLACEMENT - OFF VEHICLE (CB SERIES)**

### **Disassembly Procedure**



**Fig. 22: View Of Power Steering Pump & Reservoir (CB Series)**  
Courtesy of GENERAL MOTORS CORP.

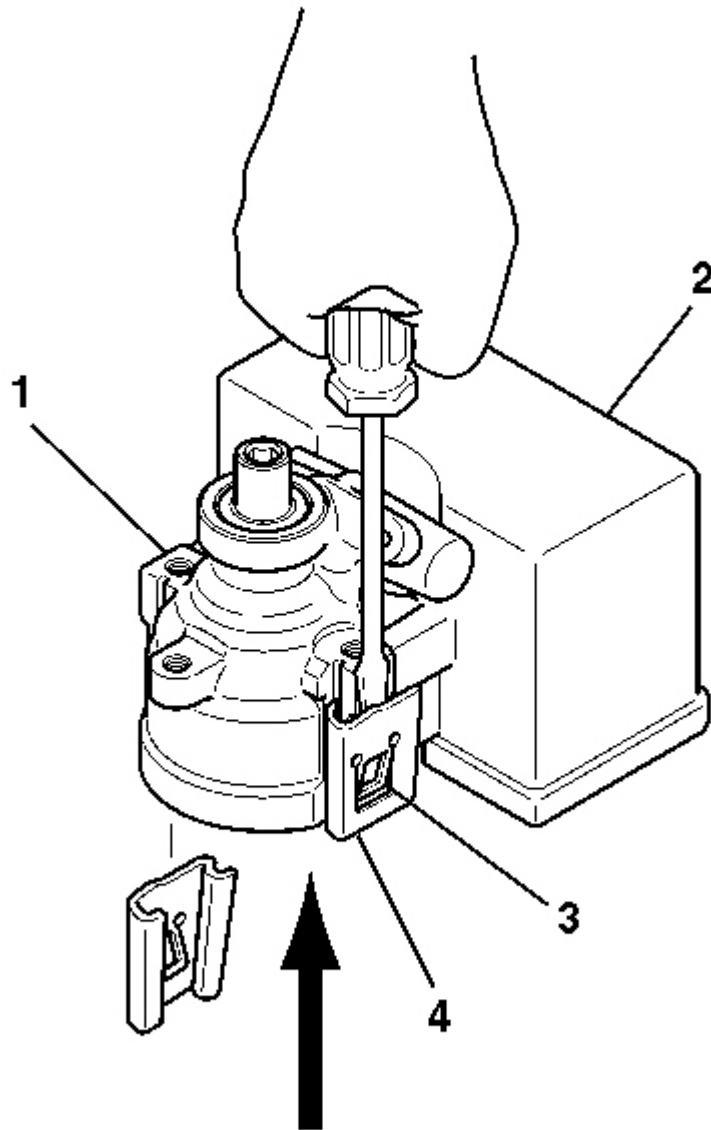


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1. Place the hydraulic pump (1) on a fixed, flat surface, with the shaft facing upward.
2. Insert a screwdriver into the retaining clip tab (3).
3. Using the screwdriver, force the retaining clip tab (3) outward.
4. Slide the reservoir clip (4) away from the hydraulic pump assembly (1).
5. Repeat the above steps to remove the second reservoir clip (4).
6. Remove the reservoir (2) from the hydraulic pump housing (1).
7. Remove the O-ring seal from the neck of the reservoir (2) or inside the hydraulic pump housing (1).  
Discard the O-ring seal.

### **Assembly Procedure**



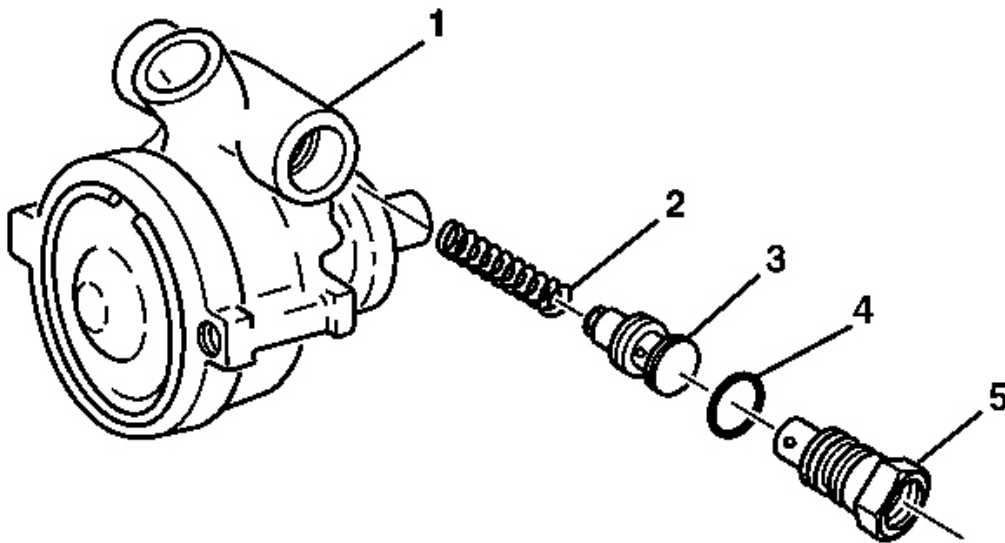
**Fig. 23: View Of Power Steering Pump & Reservoir (CB Series)**  
**Courtesy of GENERAL MOTORS CORP.**

1. Lubricate the new O-ring seal with power steering fluid.
2. Install the new O-ring seal onto the neck of the reservoir (2).
3. Install the reservoir (2) onto the hydraulic pump assembly (1). Ensure the reservoir neck is completely engaged onto the hydraulic pump assembly (1).

4. Align the feet of the reservoir with the sides of the hydraulic pump housing.
5. Install the new reservoir retaining clips (4) (supplied with the pump). Ensure the retaining clip tabs (3) fully engage with the hydraulic pump housing (1).

## **POWER STEERING PUMP FLOW CONTROL VALVE REPLACEMENT - OFF VEHICLE (CB SERIES)**

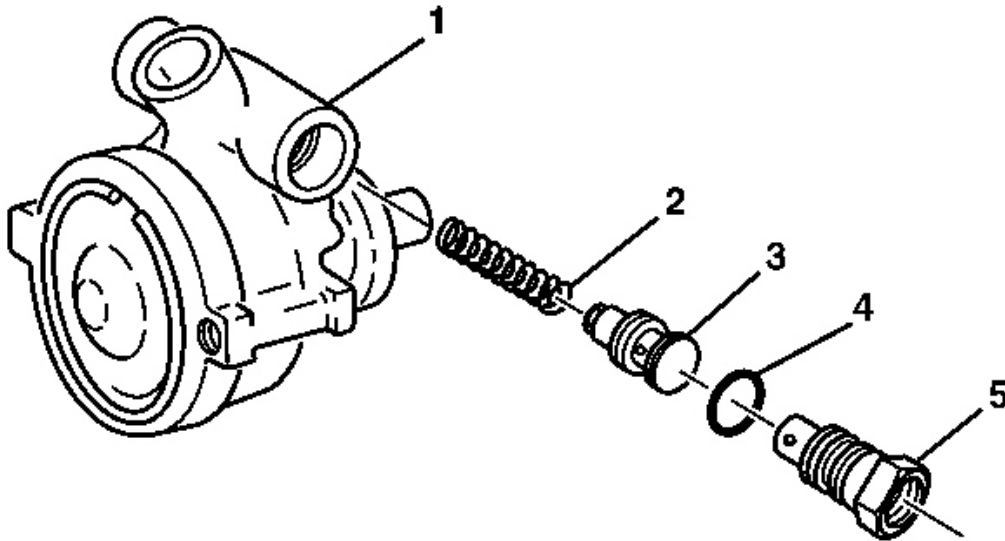
### **Disassembly Procedure**



**Fig. 24: View Of Power Steering Pump Flow Control Valve Components (CB Series)**  
**Courtesy of GENERAL MOTORS CORP.**

1. Remove the O-ring union fitting (5) from the hydraulic pump housing assembly (1).
2. Remove the O-ring seal (4) from the O-ring union fitting (5).
3. Remove the control valve assembly (3).
4. Remove the flow control spring (2).

### **Assembly Procedure**



**Fig. 25: View Of Power Steering Pump Flow Control Valve Components (CB Series)**  
Courtesy of GENERAL MOTORS CORP.

1. Install the flow control spring (2) to the hydraulic pump housing assembly (1).
2. Install the control valve assembly (3).
3. Lubricate the O-ring seal (4) with power steering fluid.
4. Install the O-ring seal (4) onto the O-ring union fitting (5).

**NOTE:** Refer to Fastener Notice .

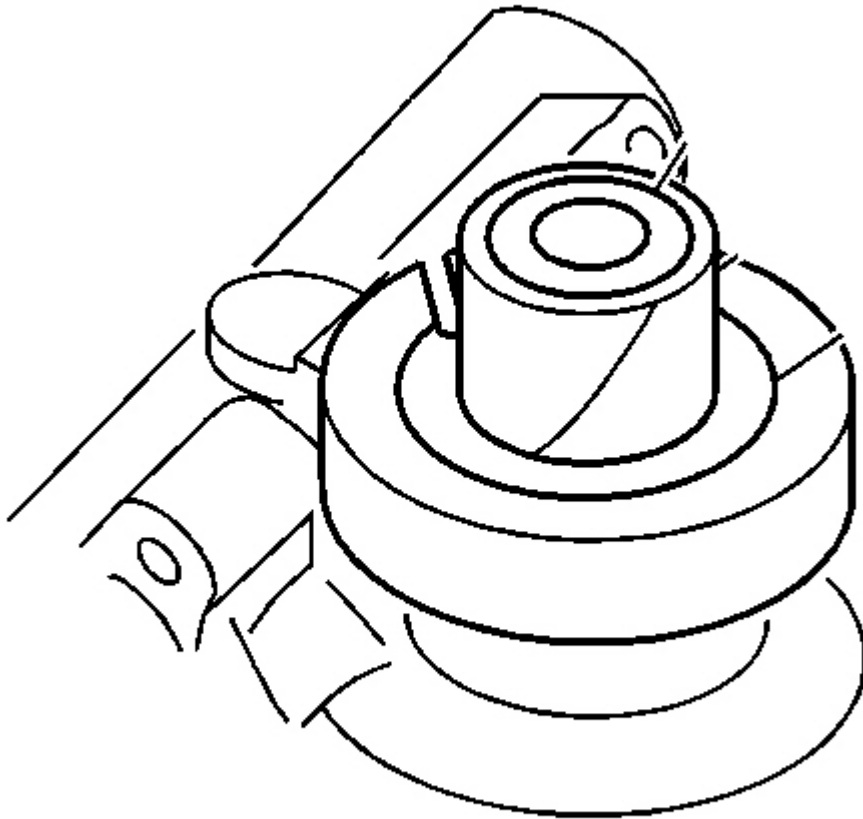
5. Install the O-ring union fitting (5) into the hydraulic pump housing assembly (1).

**Tighten:** Tighten the fitting (5) to 75 N.m (55 lb ft).

## POWER STEERING PUMP SHAFT SEAL REPLACEMENT (CB)

### Removal Procedure

1. Remove the power steering pump from the vehicle, if necessary. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)**.



**Fig. 26: Power Steering Pump Drive Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

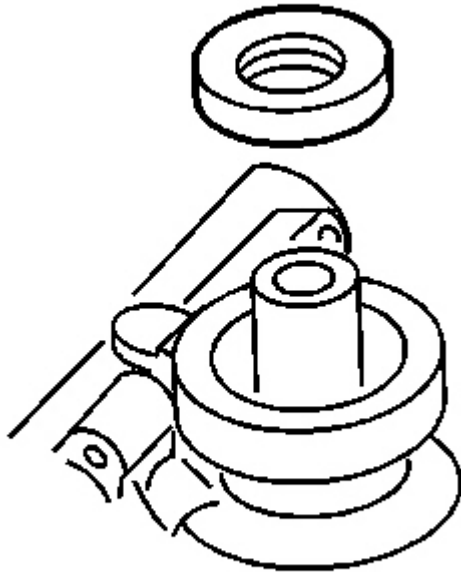
**IMPORTANT: Protect the drive shaft with the shim stock.**

2. Use a small chisel in order to remove the seal.

Discard the seal.

#### **Installation Procedure**

1. Lubricate the new drive shaft seal using power steering fluid.



**Fig. 27: Power Steering Pump Drive Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

2. Use a deep socket in order to install the new drive shaft seal.
3. Install the power steering pump, if removed. Refer to **Power Steering Pump Replacement (4.2L)** or **Power Steering Pump Replacement (Except 4.2L)**.

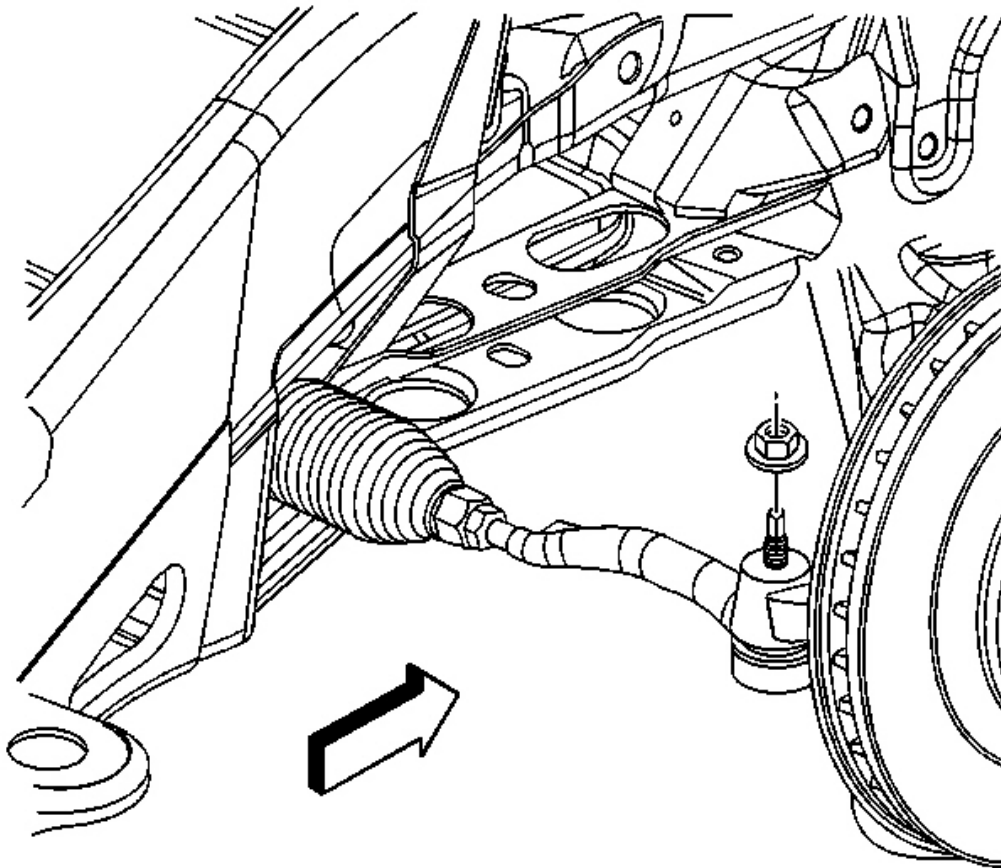
## **RACK AND PINION OUTER TIE ROD END REPLACEMENT**

### **Special Tools**

**J 24319-B** Steering Linkage and Tie Rod Puller. See **Special Tools**.

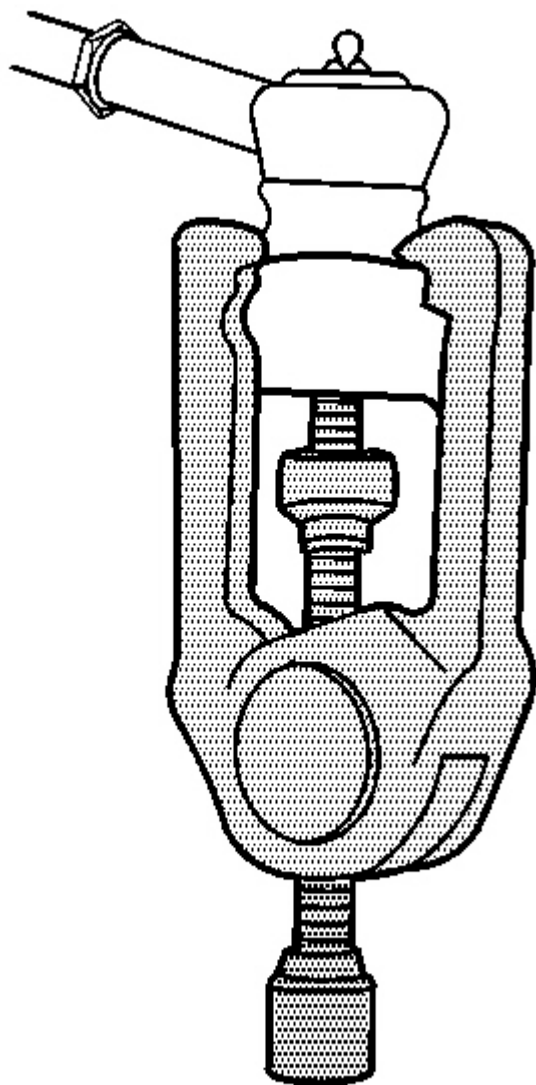
### **Removal Procedure**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .



**Fig. 28: View Of Tie Rod Retaining Nut**  
**Courtesy of GENERAL MOTORS CORP.**

3. Remove and discard the outer tie rod retaining nut.

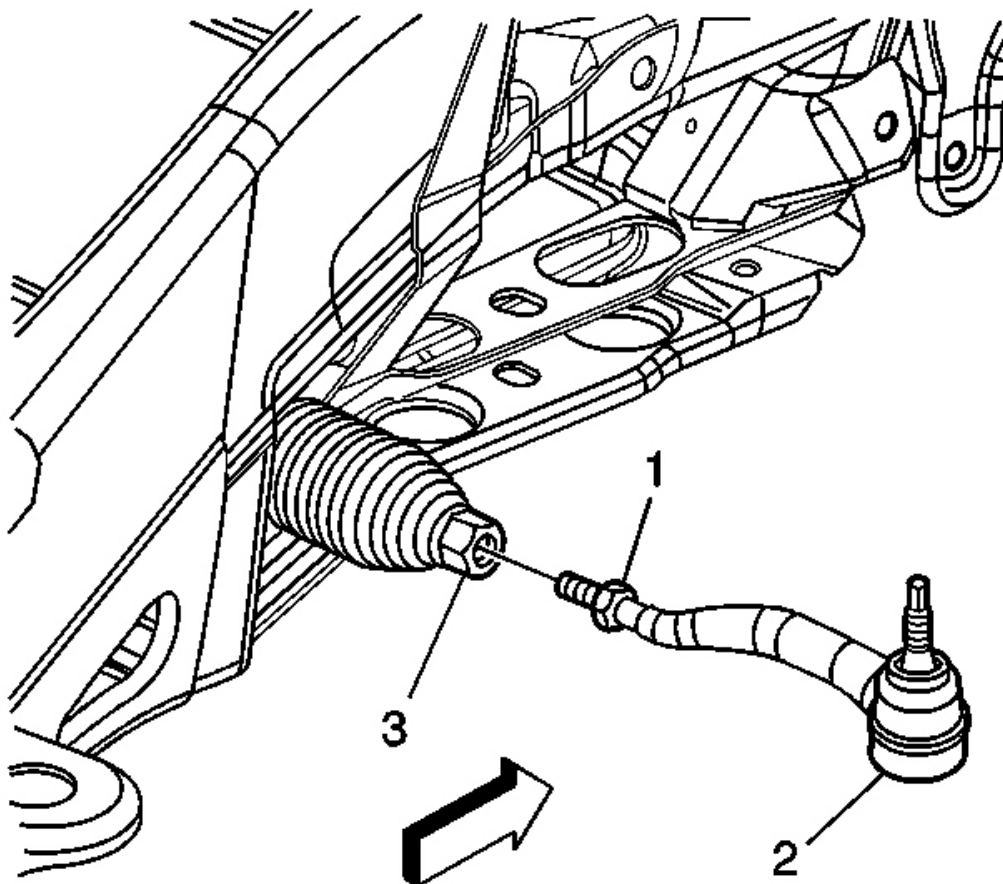


**Fig. 29: View Of Outer Tie Rod Assembly & J 24319-B**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Disconnect the outer tie rod from the steering knuckle using **J 24319-B** . See **Special Tools**.





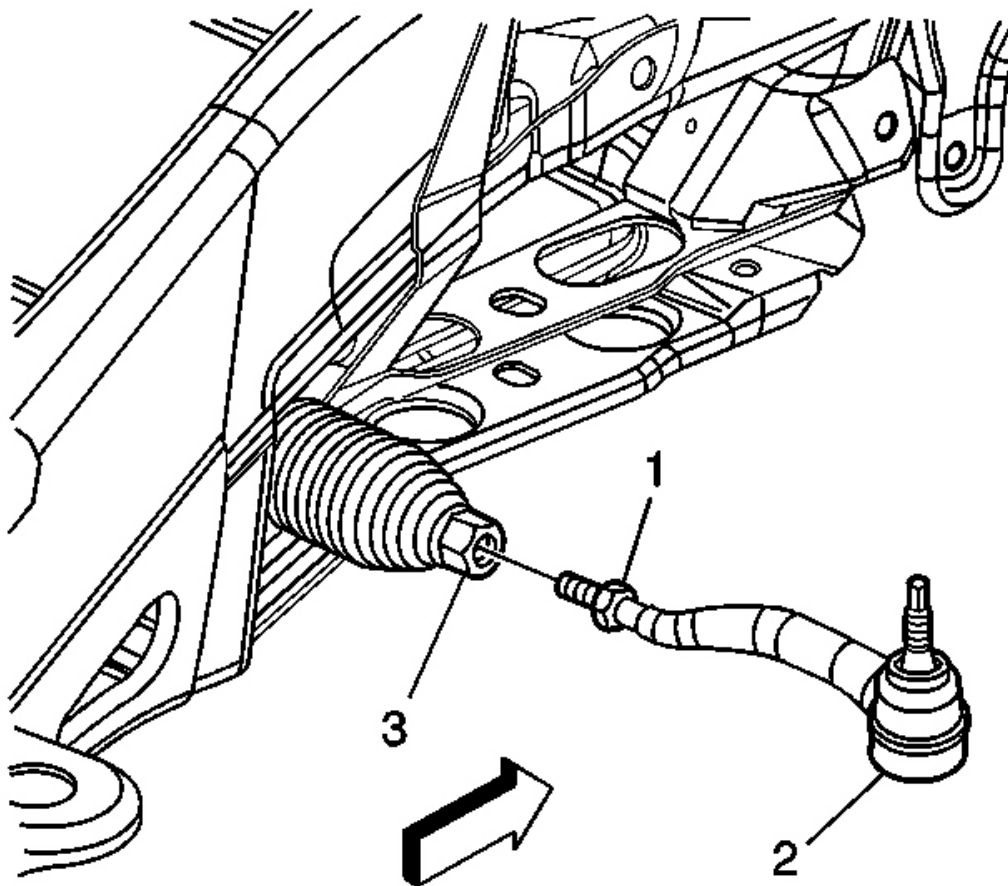
**Fig. 30: View Of Outer Tie Rod, Inner Tie Rod & Jam Nut**  
Courtesy of GENERAL MOTORS CORP.

5. Loosen the jam nut (1) and remove the outer tie rod (2) from the inner tie rod (3).

Do not reuse the jam nut.

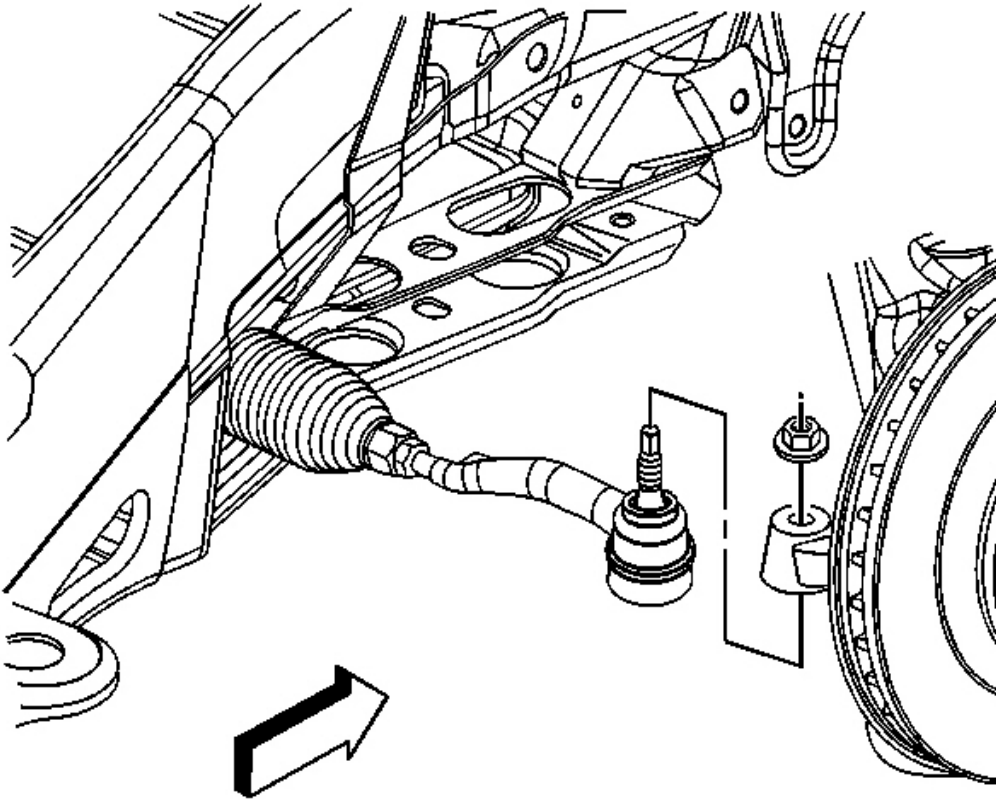
6. Inspect the shaft for bent or damaged threads.
7. Clean the tapered surface of the steering knuckle.

#### **Installation Procedure**



**Fig. 31: View Of Outer Tie Rod, Inner Tie Rod & Jam Nut**  
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the inner tie rod (3) threads with a suitable chassis lubricant before installing the outer tie rod (2).
2. Install the new jam nut (1) to the outer tie rod (2).
3. Install the outer tie rod (2) to the inner tie rod (3).



**Fig. 32: View Of Tie Rod & Steering Knuckle**  
Courtesy of GENERAL MOTORS CORP.

4. Install the outer tie rod to the steering knuckle.

**NOTE:** Refer to **Fastener Notice** .

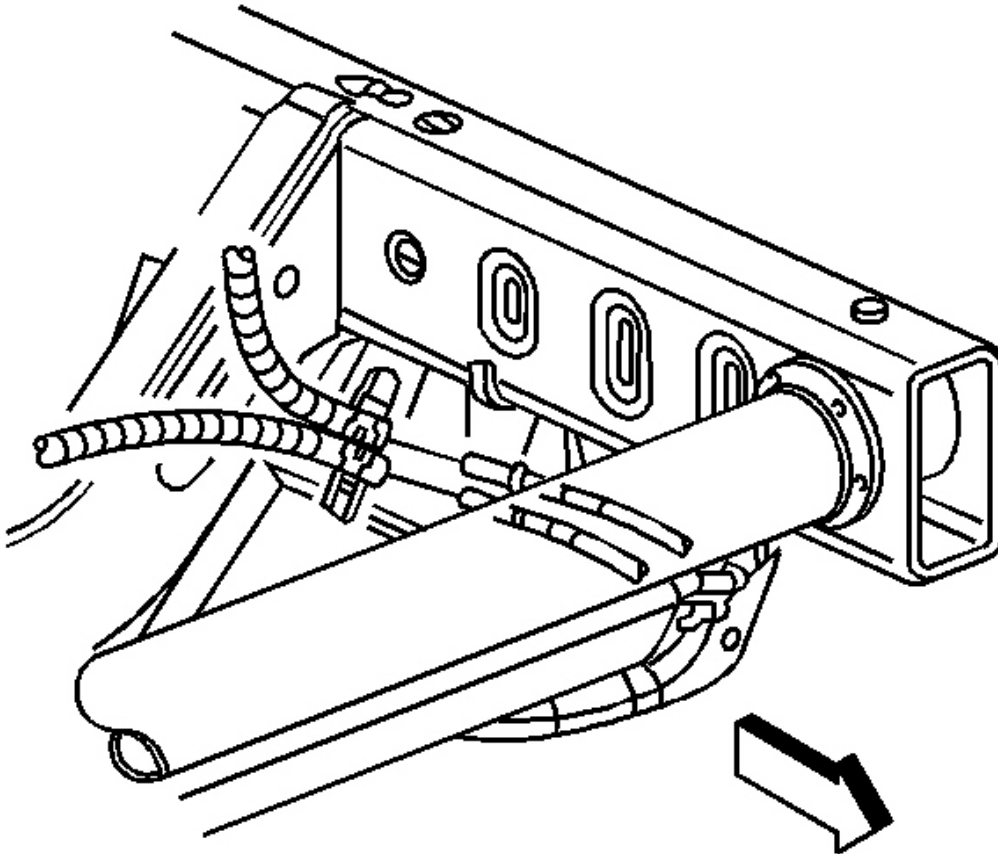
5. Install the new outer tie rod retaining nut.

**Tighten:** Tighten the outer tie rod retaining nut to 57 N.m (42 lb ft).

6. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
7. Lower the vehicle.
8. Adjust the front toe. Refer to **Front Toe Adjustment** .

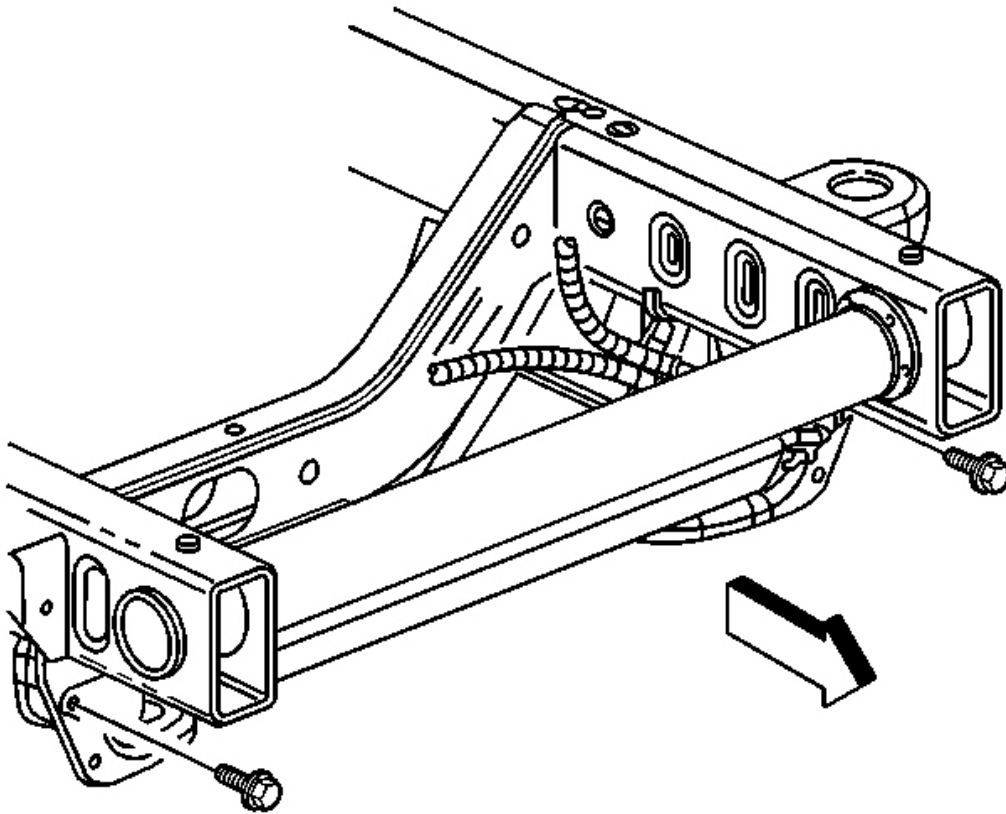
**Removal Procedure**

1. Remove the front air dam deflector. Refer to **Front Bumper Fascia Air Deflector Replacement** .



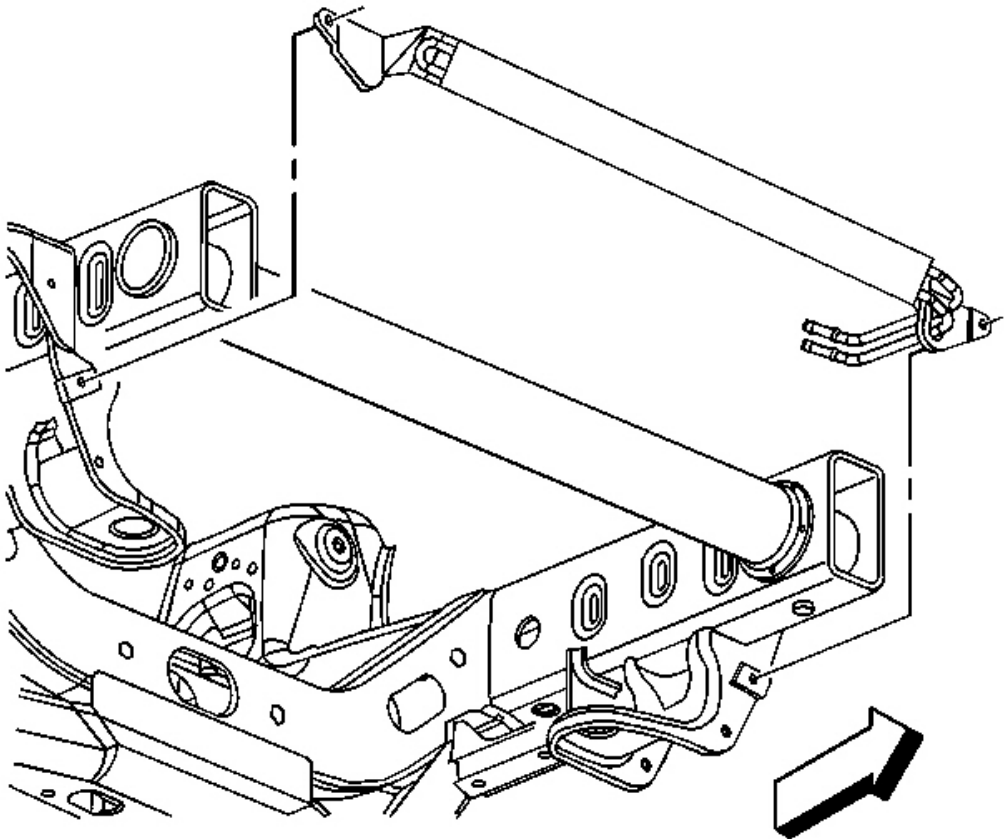
**Fig. 33: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

2. Install a drain pan under the vehicle.
3. Disconnect the power steering hose assembly from the power steering cooler.



**Fig. 34: View Of Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

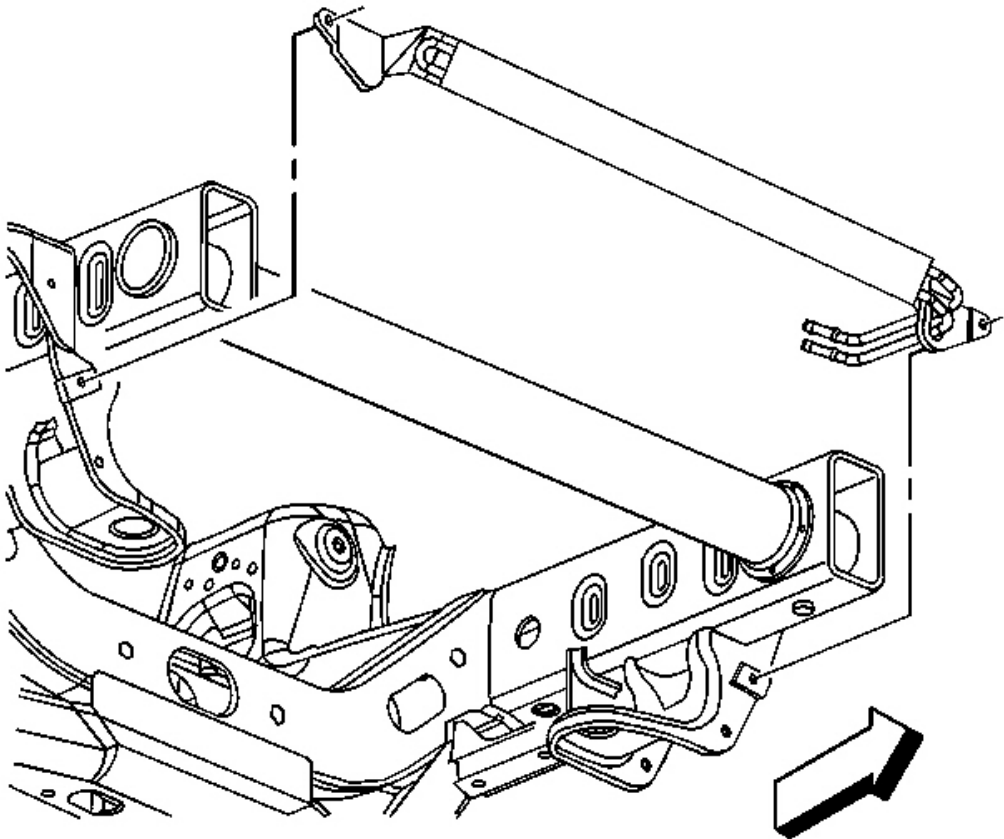
4. Remove the power steering cooler mounting bolts.



**Fig. 35: View Of Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

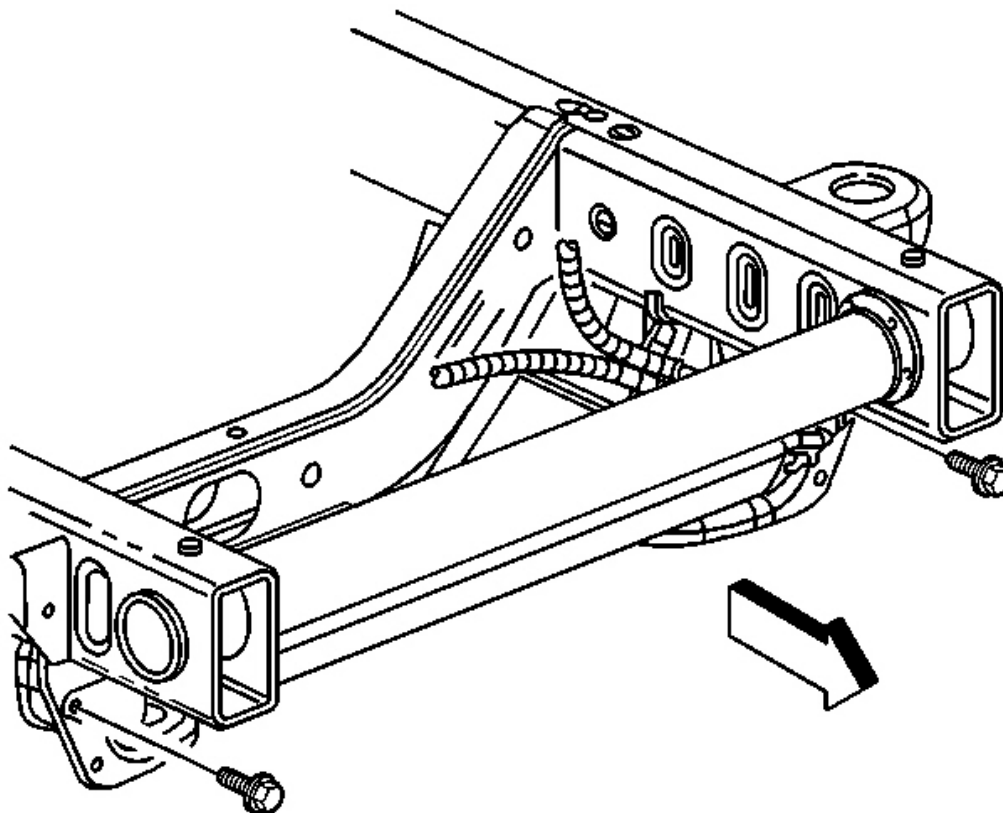
5. Remove the power steering cooler from the radiator support.

#### **Installation Procedure**



**Fig. 36: View Of Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

1. Install the power steering cooler to the radiator support.



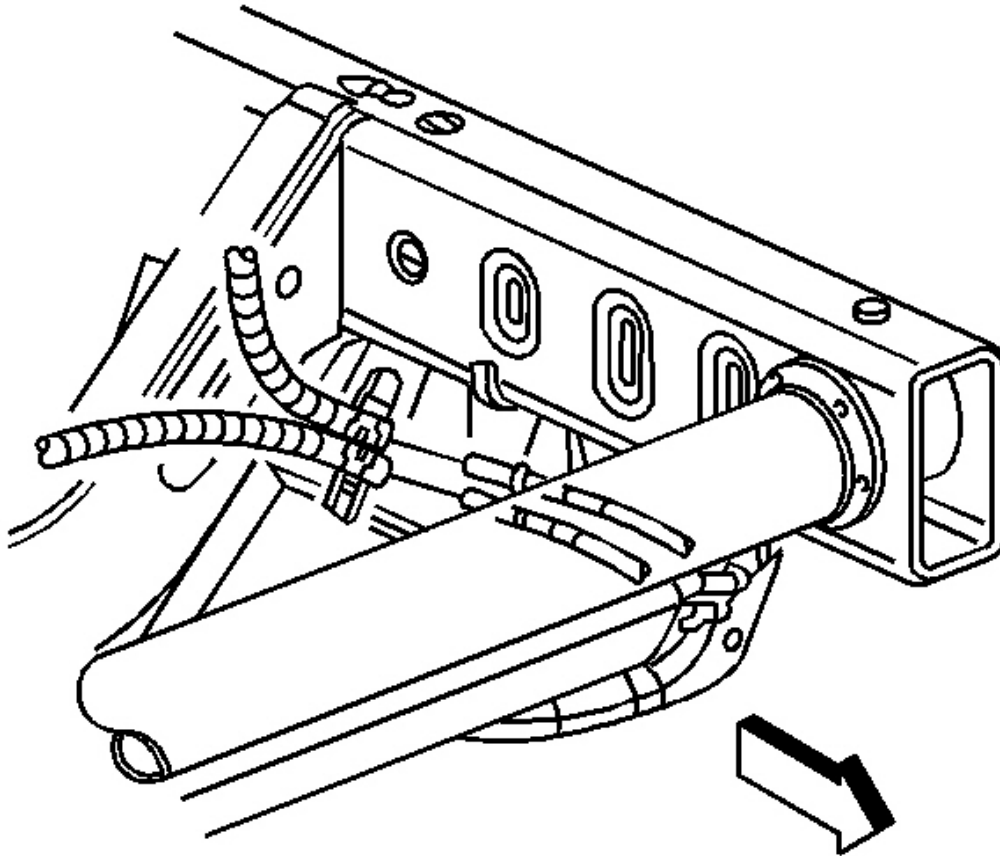
**Fig. 37: View Of Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to **Fastener Notice** .

2. Install the power steering cooler mounting bolts.

**Tighten:** Tighten the power steering cooler mounting bolts to 20 N.m (15 lb ft).





**Fig. 38: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

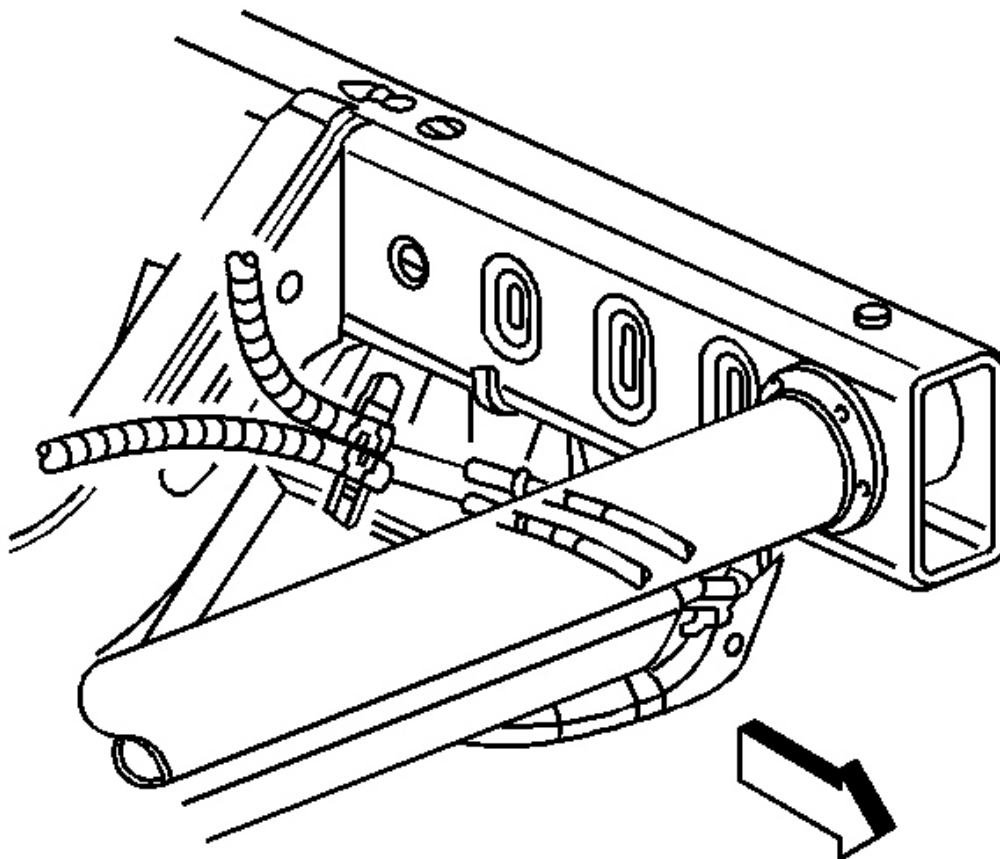
3. Connect the power steering hoses assembly to the power steering cooler.
4. Remove drain pan from under the vehicle.
5. Install the front air deflector. Refer to **Front Bumper Fascia Air Deflector Replacement** .
6. Bleed the power steering system. Refer to **Power Steering System Bleeding**.

## **POWER STEERING FLUID COOLER REPLACEMENT (EXCEPT 4.2L)**

### **Removal Procedure**

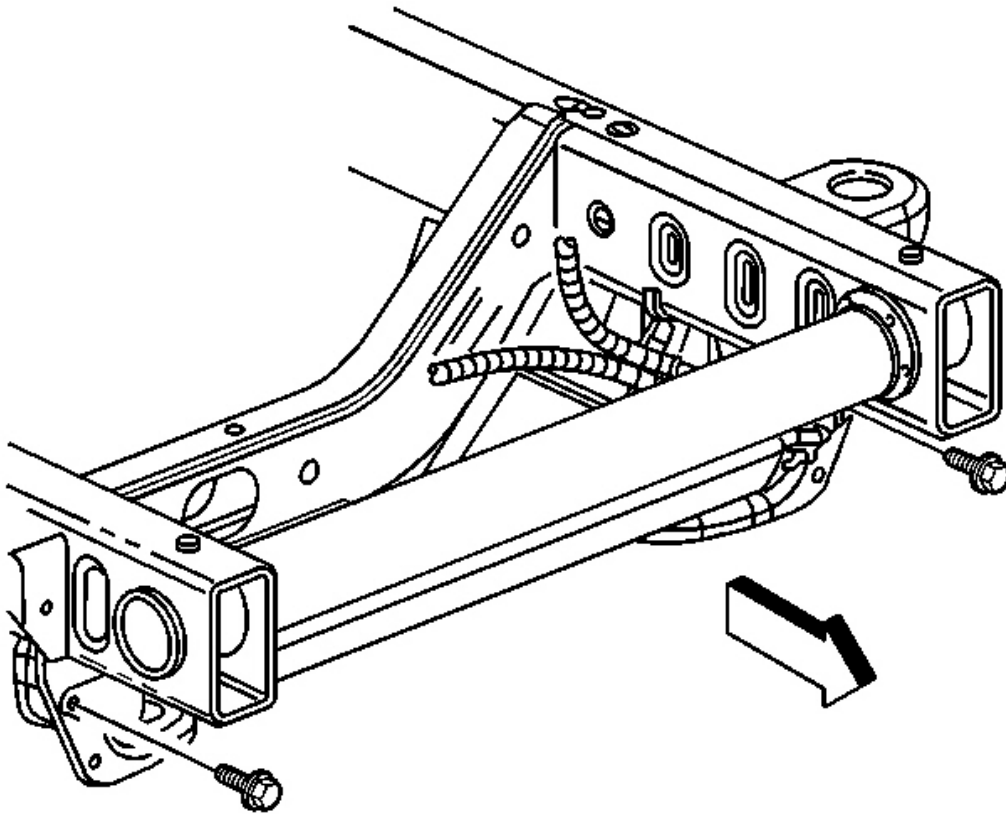
1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Place drain pan under vehicle.
3. Remove the front fascia. Refer to **Front Bumper Fascia Replacement (Envoy)** or **Front Bumper**

**Fascia Replacement (TrailBlazer) .**



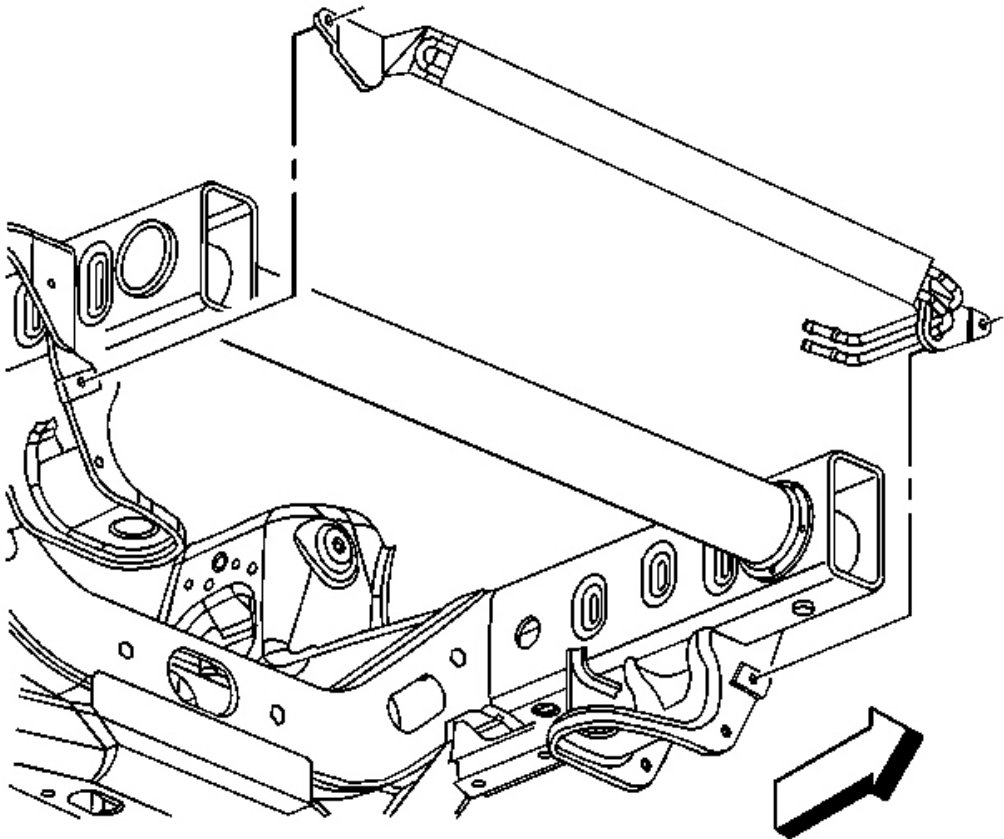
**Fig. 39: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the power steering cooler hoses from the power steering cooler.



**Fig. 40: View Of Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

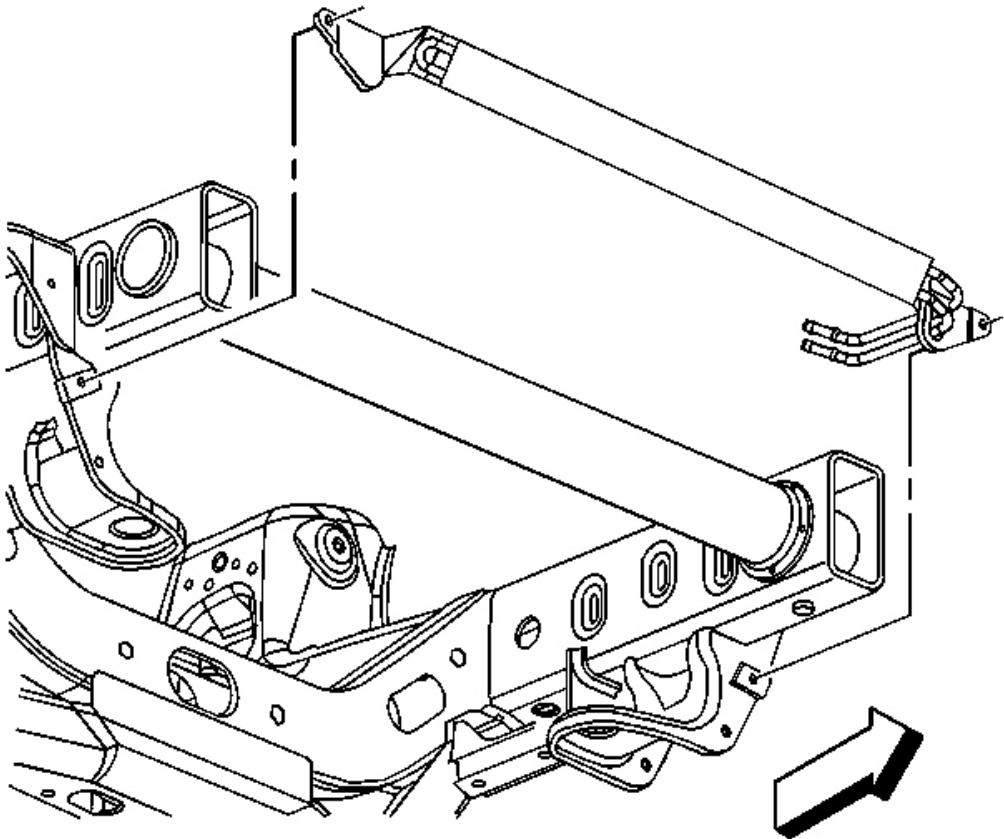
5. Remove the power steering cooler mounting bolts.



**Fig. 41: View Of Power Steering Cooler**  
**Courtesy of GENERAL MOTORS CORP.**

6. Remove the power steering cooler from the radiator support.

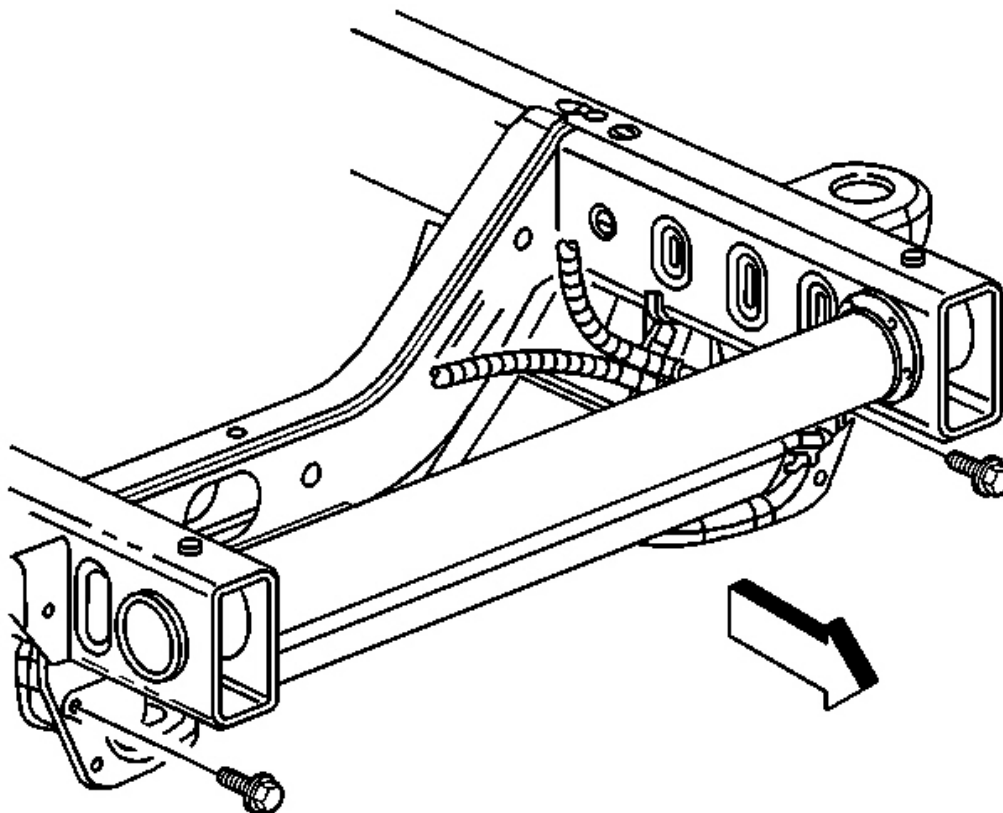
#### **Installation Procedure**



**Fig. 42: View Of Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

1. Install the power steering cooler to the radiator support.

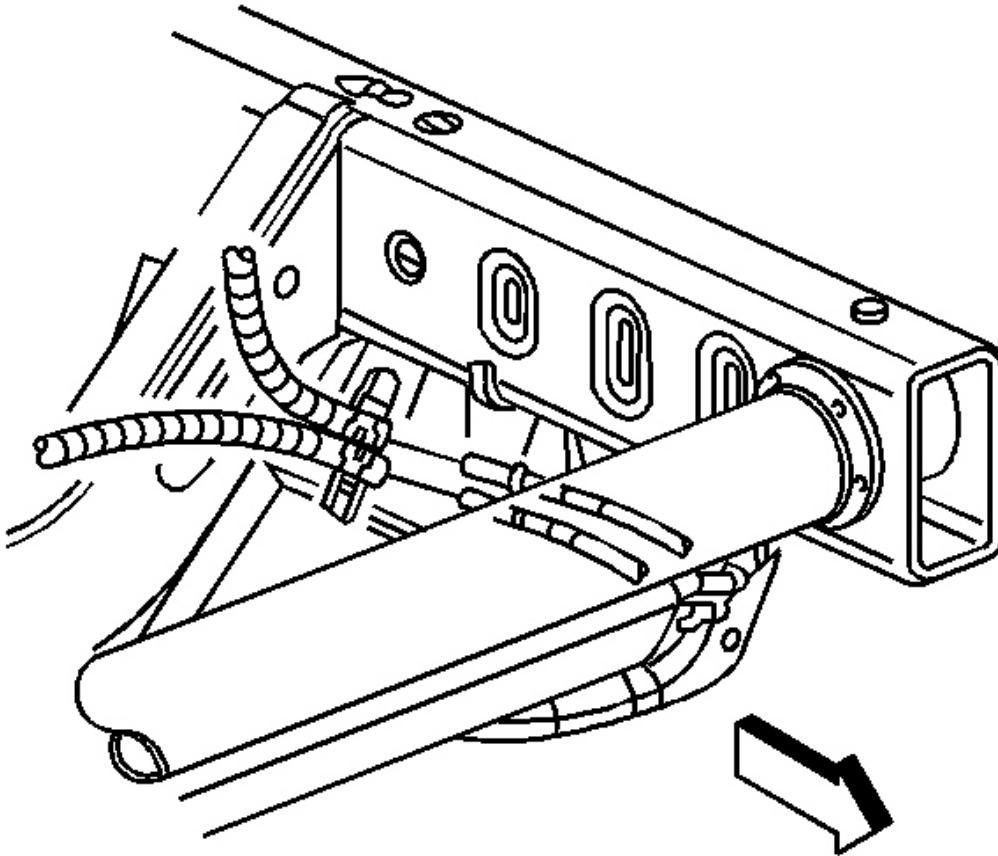
**NOTE:** Refer to Fastener Notice .



**Fig. 43: View Of Power Steering Cooler Mounting Bolts**  
Courtesy of GENERAL MOTORS CORP.

2. Install the power steering cooler mounting bolts.

**Tighten:** Tighten the power steering cooler mounting to 20 N.m (15 lb ft).



**Fig. 44: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

3. Connect the power steering cooler hoses to the power steering cooler.
4. Install the front fascia. Refer to **Front Bumper Fascia Replacement (Envoy)** or **Front Bumper Fascia Replacement (TrailBlazer)** .
5. Remove the drain pan from under the vehicle.
6. Lower the vehicle.
7. Bleed the power steering system. Refer to **Power Steering System Bleeding**.

## **POWER STEERING GEAR INLET & OUTLET HOSE REPLACEMENT (4.2L)**

### **Tools Required**

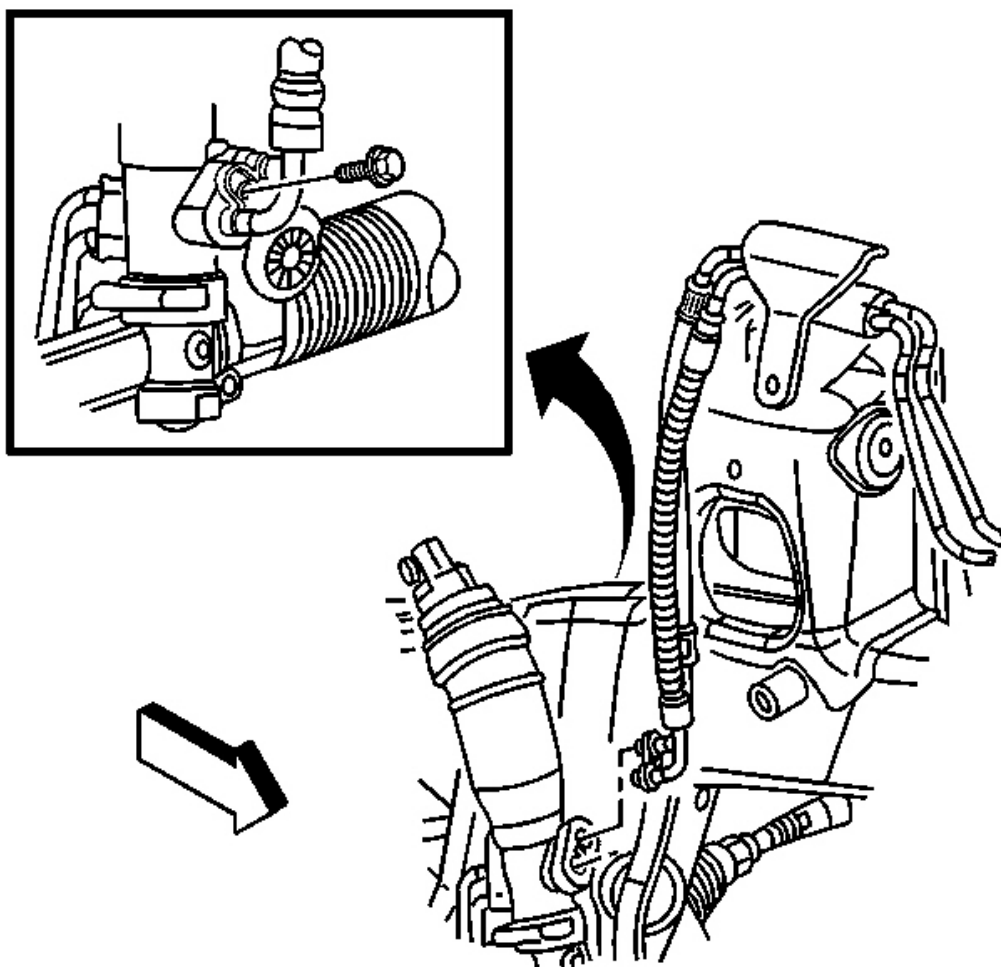
**J 44586** Power Steering Gear Oil Seal Remover/Installer. See **Special Tools**.

### Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the engine protection shield. Refer to **Engine Protection Shield Replacement** .

**NOTE:** Refer to **Power Steering Hose Disconnected Notice** .

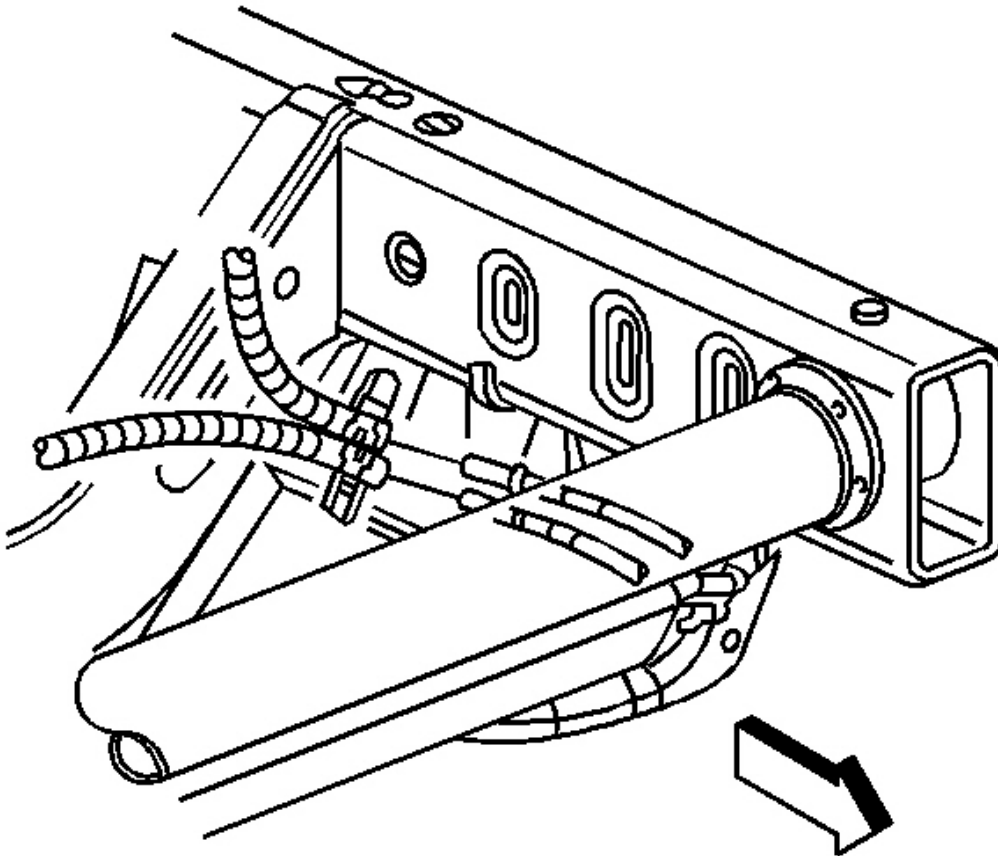
3. Install the drain pan under the vehicle.



**Fig. 45: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

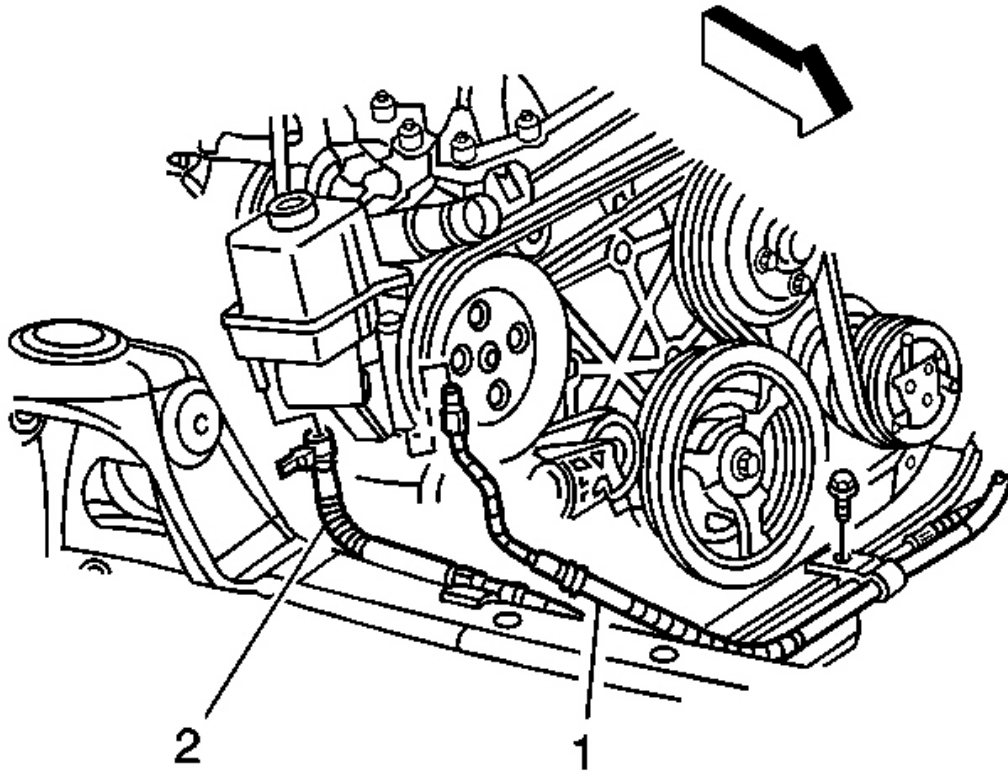


4. Remove the power steering hose assembly to the power steering gear retaining bolt.
5. Disconnect the power steering hose assembly from the power steering gear.



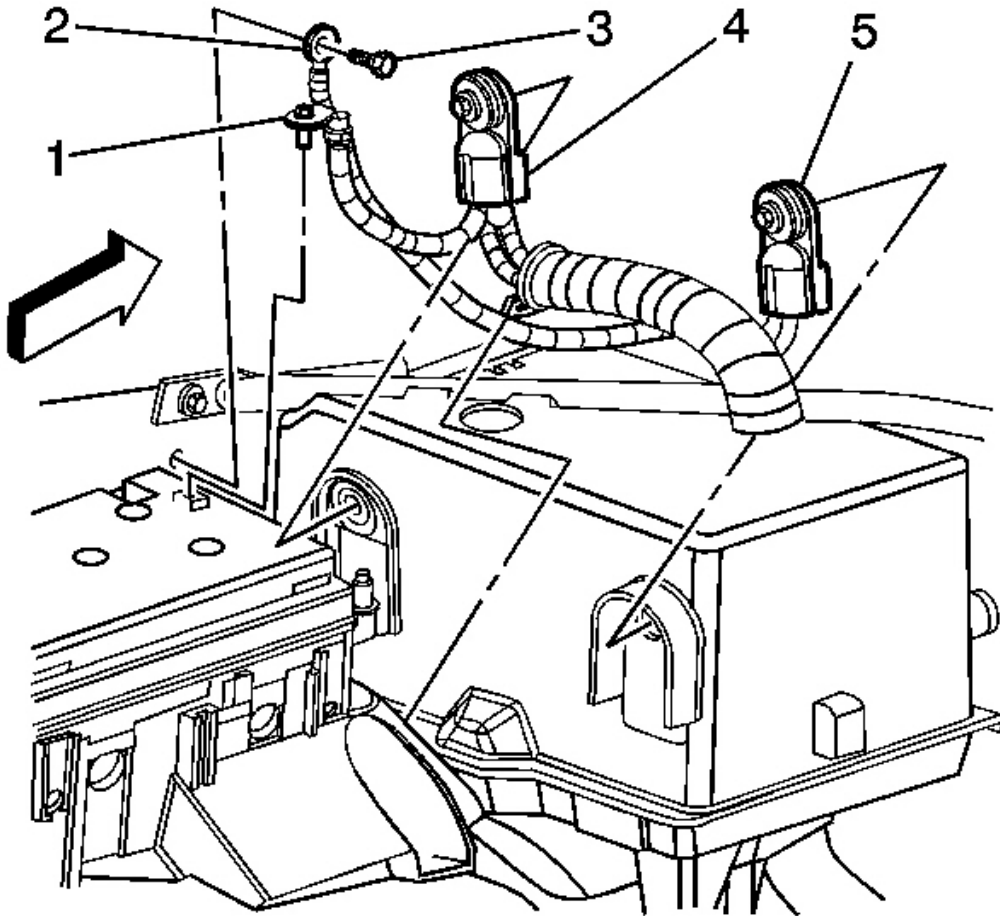
**Fig. 46: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the power steering return hose and power steering cooler hose from the power steering cooler.



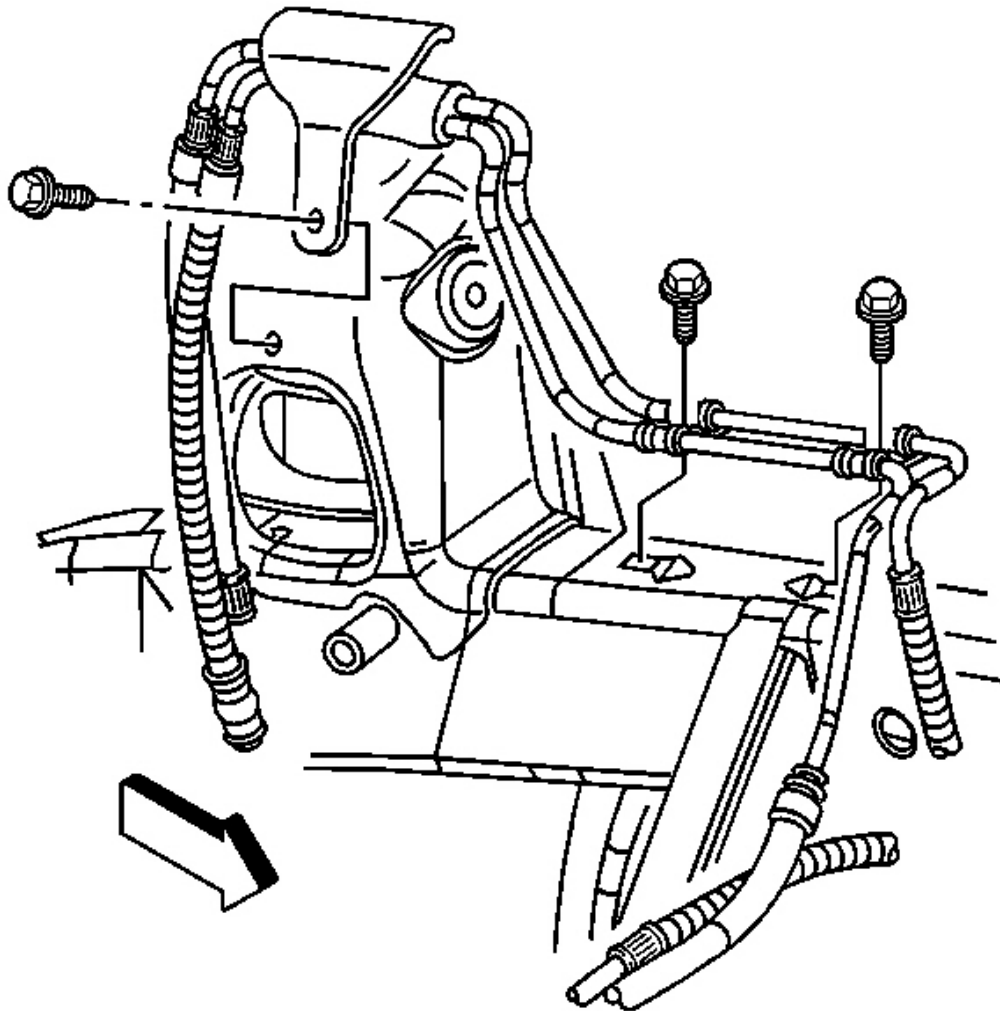
**Fig. 47: Identifying Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the power steering pressure hose (1) and power steering cooler hose (2) from the power steering pump.
8. Lower the vehicle.
9. Remove the power steering hose assembly to front crossmember bracket mounting bolt.
10. Remove the battery tray. Refer to **Battery Tray Replacement** .



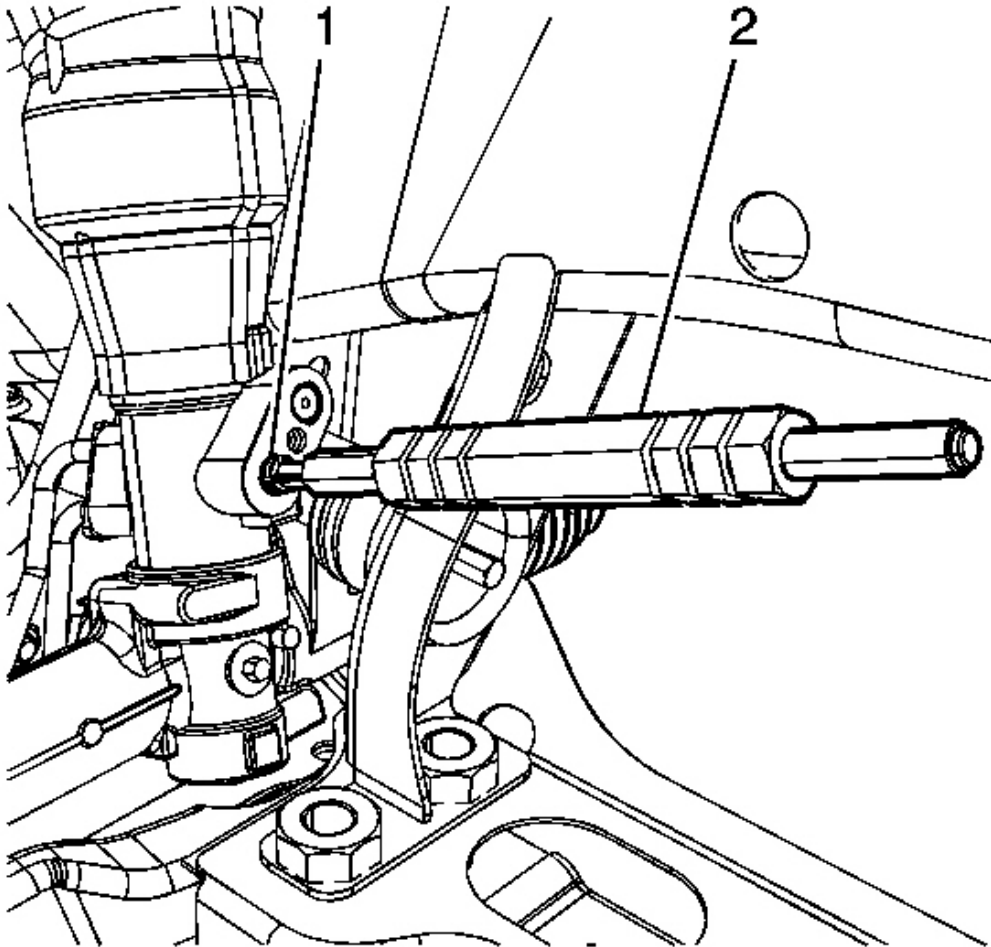
**Fig. 48: Identifying Battery Cable Components**  
**Courtesy of GENERAL MOTORS CORP.**

11. Remove the fuse block cover.
12. Disconnect the negative battery cable (5) from the fender and fuse block.
13. Disconnect the positive battery cable (4) from the fuse block.
14. Disconnect the wiring harness connector from the fuse block and remove from bracket.
15. Disconnect the fuse block wiring harnesses from the wiring loops.
16. Disconnect the wiring harness clips from the fender.
17. Disconnect the upper fuse block locking tabs to lower fuse block.
18. Remove the upper fuse block bolts.
19. Remove the upper fuse block assembly from lower fuse block and set the upper fuse block on the engine.



**Fig. 49: View Of Power Steering Hose Assembly & Bracket At Wheel Well**  
Courtesy of GENERAL MOTORS CORP.

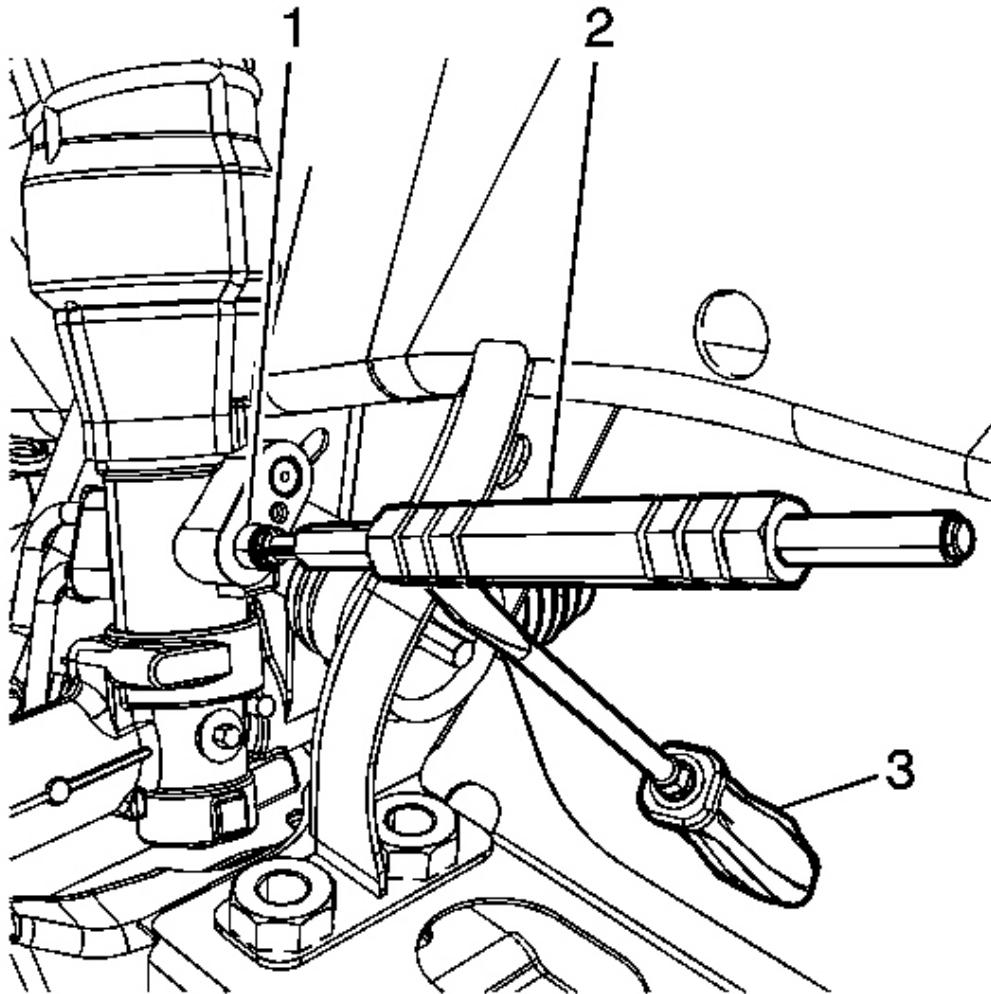
20. Remove the power steering hose assembly bracket retaining bolt at the wheel well.
21. Remove the power steering hose assembly bracket from the wheel well.
22. Remove the power steering hose assembly to frame brackets retaining bolts.
23. Remove the power steering hose assembly from the vehicle.
24. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .



**Fig. 50: Identifying Seal Extractor J 44586**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Clean the power steering gear inlet and outlet ports thoroughly of any debris. Failure to do so could result in contamination and damage to the power steering system components.

25. Install the seal extraction end of the **J 44586** (2) to the power steering gear oil seal (1). See **Special Tools**.

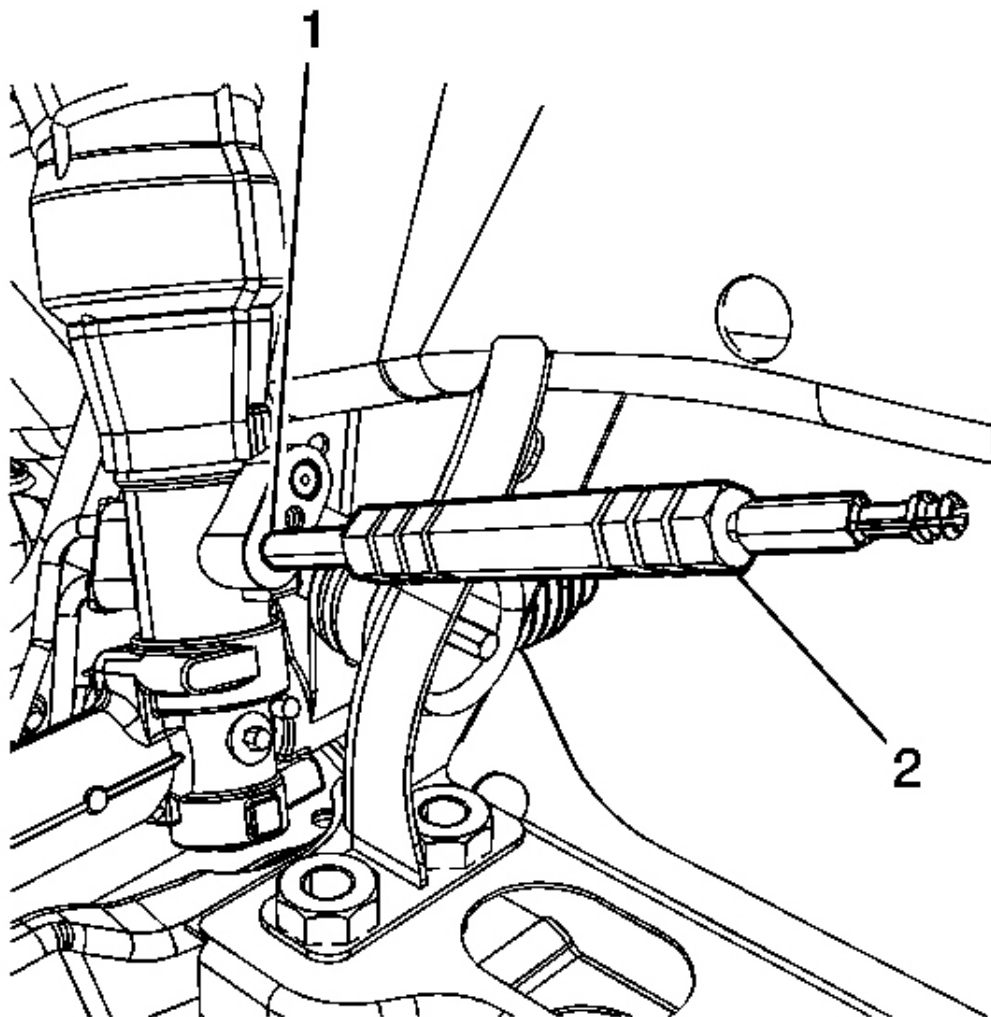


**Fig. 51: Removing Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

26. Extract the power steering gear oil seal (1) from the power steering gear using the **J 44586** (2) with the aid of a flat-bladed tool (3) for additional leverage. See **Special Tools**.
27. With the hose assembly on a work bench, note the location of the hoses.
28. Remove the 3 retaining clamps. Note the location for assembly.
29. Remove the damaged power steering hose.

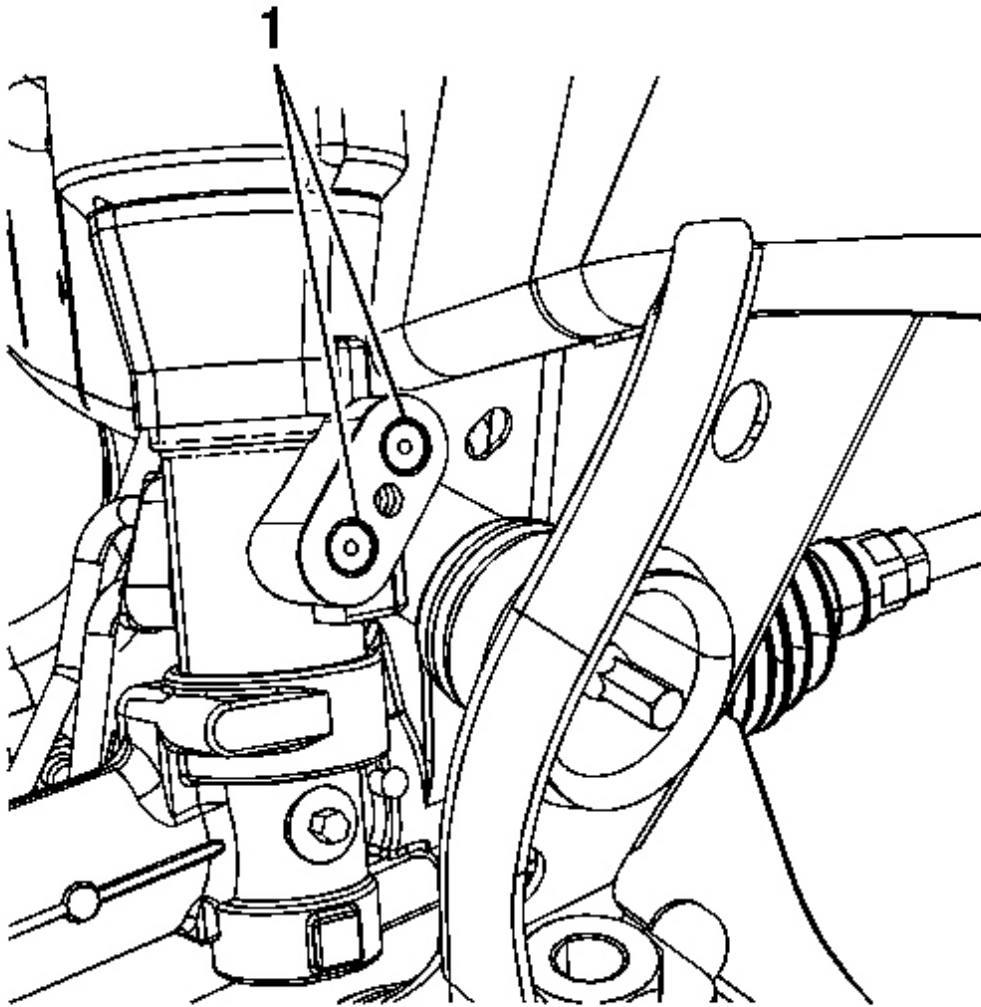
#### Installation Procedure

1. Place the replacement hose into the hose assembly.
2. Install the 3 retaining clamps as noted during disassemble.



**Fig. 52: Identifying Steering Gear Oil Seal Installer End Of J 44586**  
Courtesy of GENERAL MOTORS CORP.

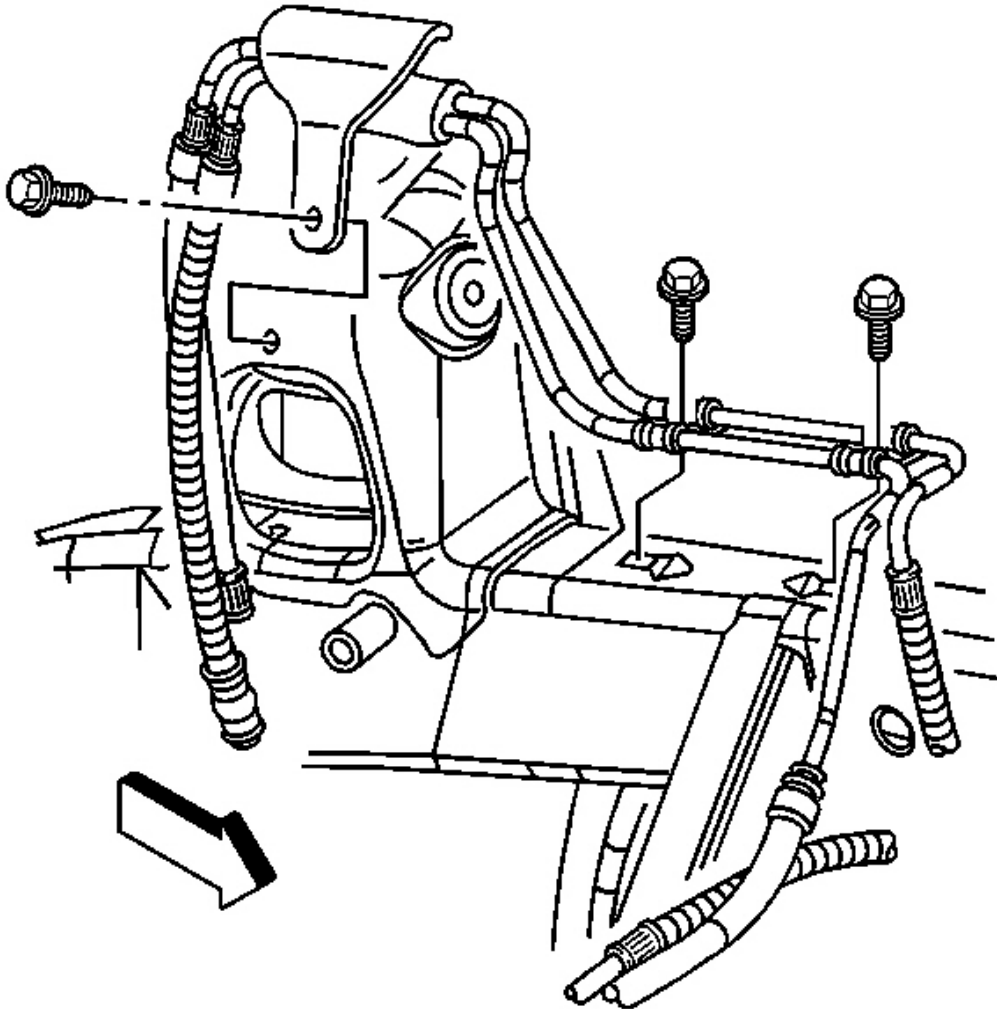
3. Install the NEW power steering gear oil seal (1) to the power steering gear using the seal installation end of the **J 44586** (2). See **Special Tools**.



**Fig. 53: View Of Power Steering Gear Oil Seals**  
**Courtesy of GENERAL MOTORS CORP.**

4. Ensure the power steering gear oil seals (1) are fully seated in the power steering gear.
5. Lower the vehicle.
6. Install the power steering hose assembly to the vehicle.





**Fig. 54: View Of Power Steering Hose Assembly & Bracket At Wheel Well**  
Courtesy of GENERAL MOTORS CORP.

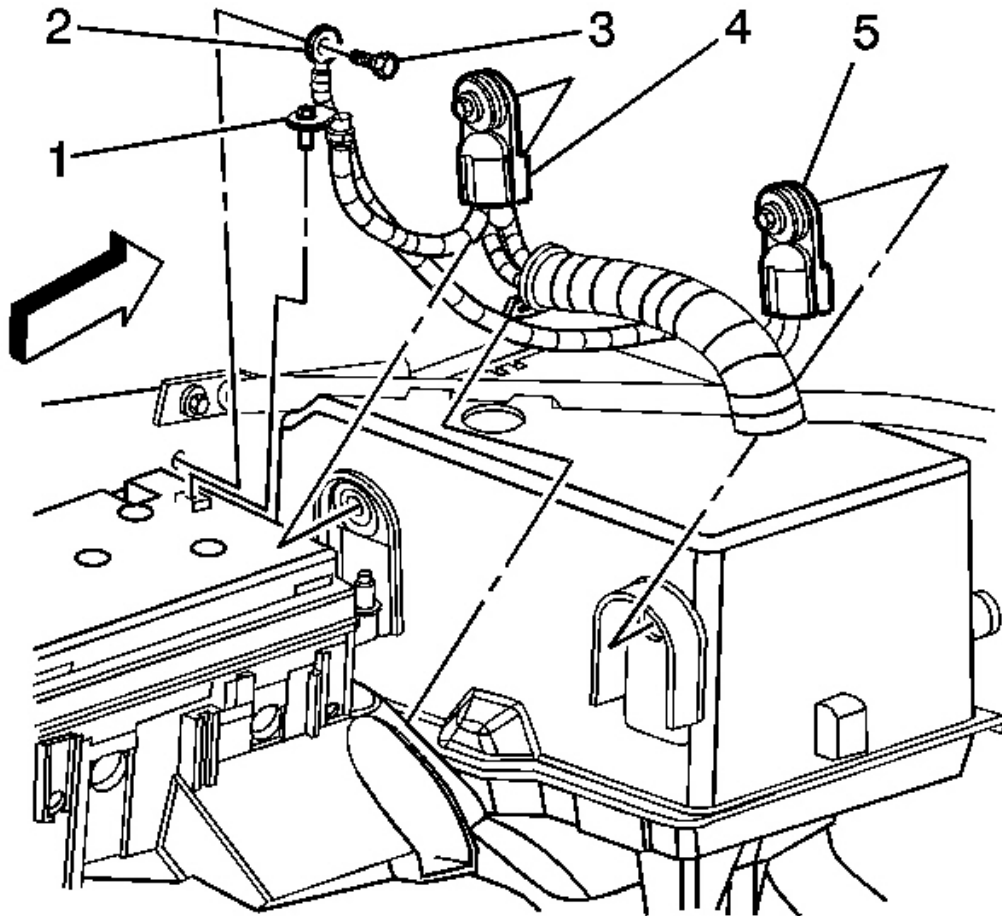
**NOTE:** Refer to Fastener Notice .

7. Install the power steering hose assembly to frame brackets retaining bolts.

**Tighten:** Tighten the bolts to 10 N.m (89 lb in).

8. Install the power steering hose assembly bracket to the wheel well.
9. Install the power steering hose assembly bracket retaining bolt at the wheel well.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).



**Fig. 55: Identifying Battery Cable Components**

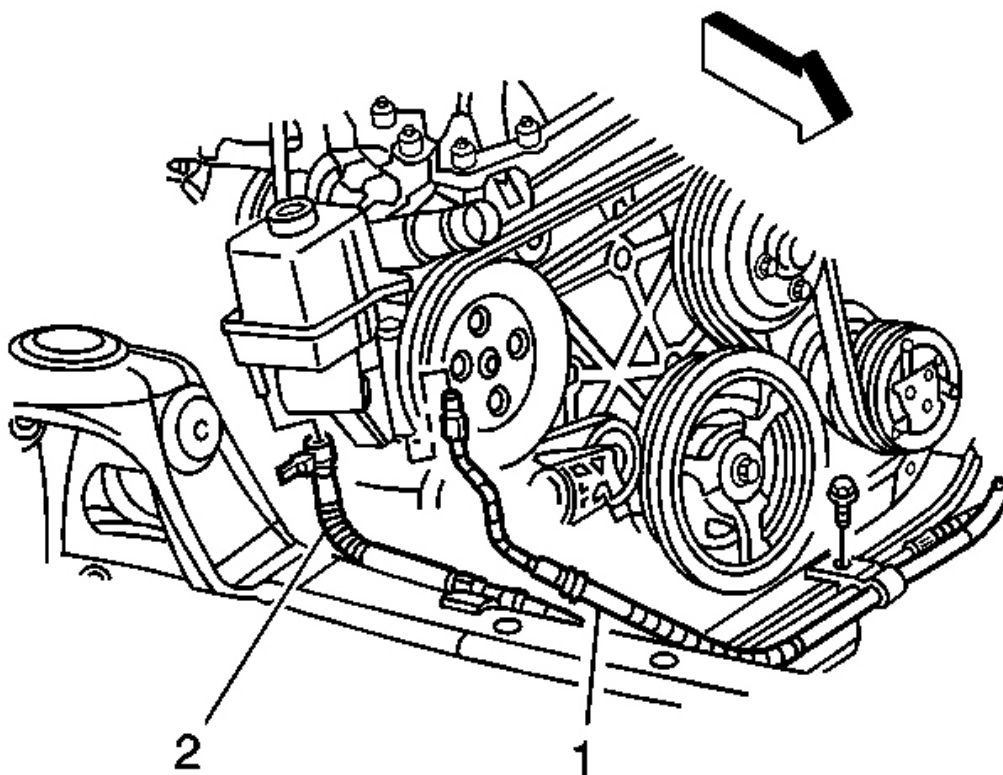
Courtesy of GENERAL MOTORS CORP.

10. Ensure the connectors are properly positioned in the lower fuse block.
11. Install the upper fuse block assembly to lower fuse block.
12. Connect the upper fuse block locking tabs to the lower fuse block.
13. Install the upper fuse block bolts.

**Tighten:** Tighten the bolt to 6 N.m (53 lb in).

14. Connect the wiring harness clips from fender.

15. Connect the fuse block wiring harnesses to the wiring loops.
16. Connect the wiring harness connector to the fuse block.
17. Connect the positive battery cable (4) to the fuse block.
18. Connect the negative battery cable (5) to the fender and fuse block.
19. Install the fuse block cover.
20. Install the battery tray. Refer to **Battery Tray Replacement** .



**Fig. 56: Identifying Power Steering Hoses**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Refer to **Component Fastener Tightening Notice** .

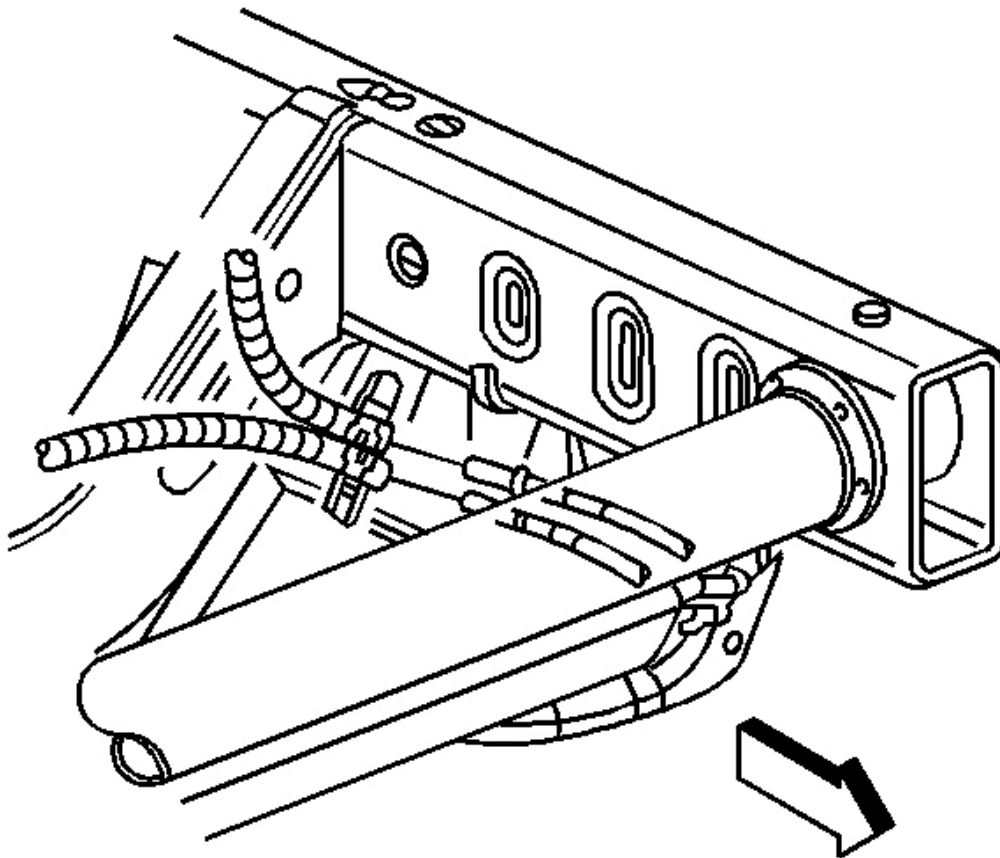
21. Install the power steering hose assembly to front crossmember bracket mounting bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

22. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**

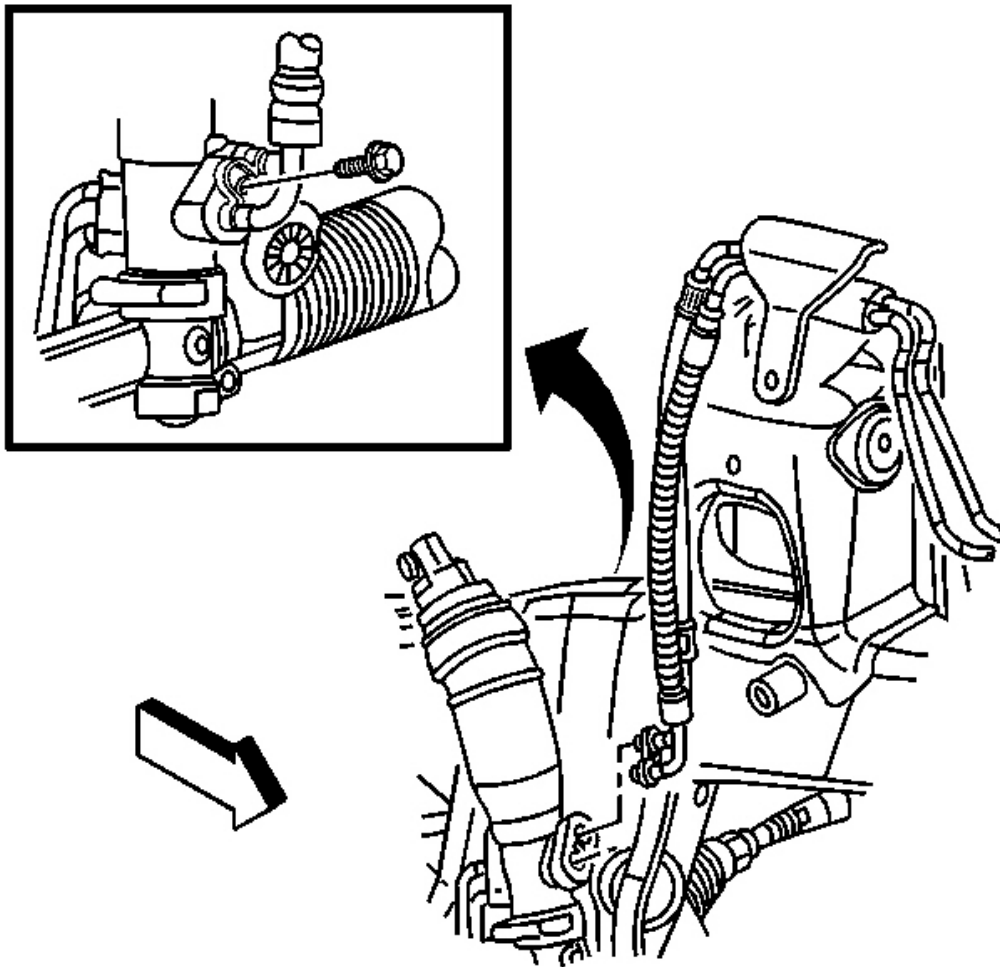
23. Install the power steering cooler hose (2) to the power steering pump.
24. Install the power steering pressure hose (1) to the power steering pump.

**Tighten:** Tighten the bolt to 25 N.m (18 lb ft).



**Fig. 57: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

25. Install the power steering return hose and the power steering cooler hose to the power steering cooler as shown.



**Fig. 58: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

26. Connect the power steering hose assembly to the power steering gear.
27. Install the power steering hose assembly to power steering gear retaining bolt.

**Tighten:** Tighten the bolt to 12 N.m (106 lb in).

28. Remove the drain pan from under the vehicle.
29. Install the engine protection shield. Refer to **Engine Protection Shield Replacement** .
30. Lower the vehicle.
31. Bleed the power steering system. Refer to **Power Steering System Bleeding**.

## **POWER STEERING GEAR INLET & OUTLET HOSE REPLACEMENT (EXCEPT 4.2L)**

### **Tools Required**

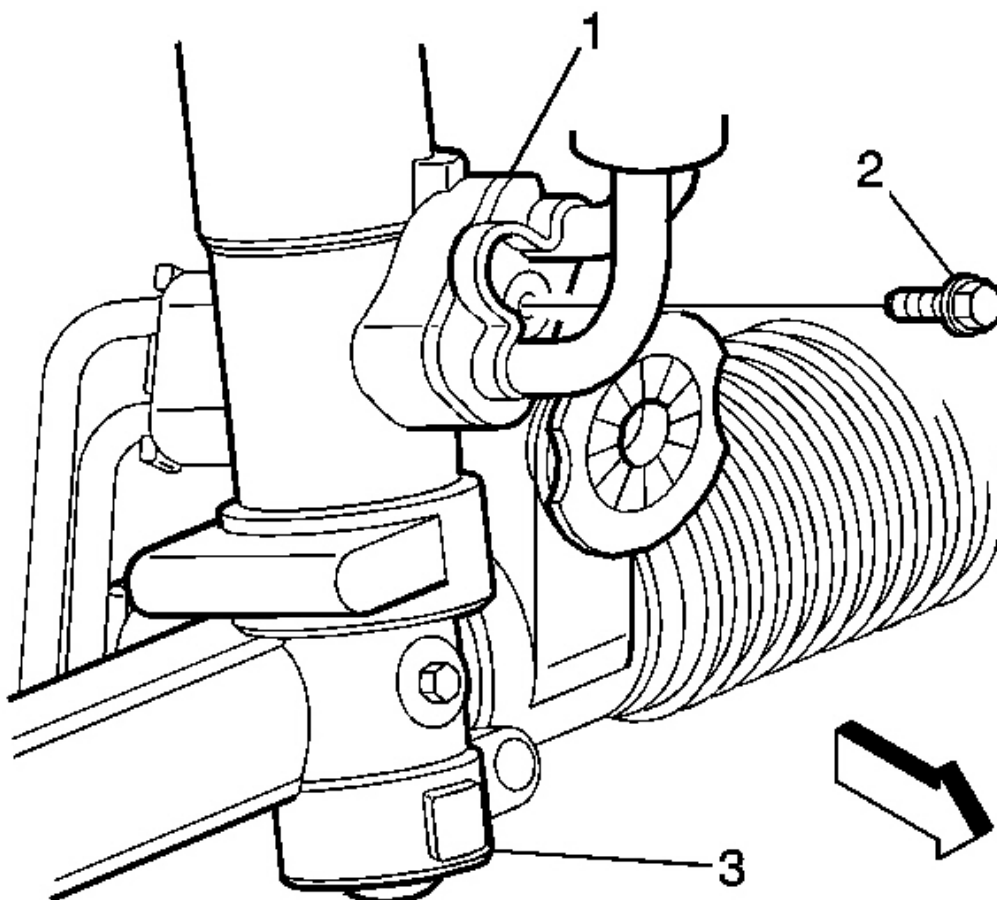
**J 44586** Power Steering Gear Oil Seal Remover/Installer. See **Special Tools**.

### **Removal Procedure**

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

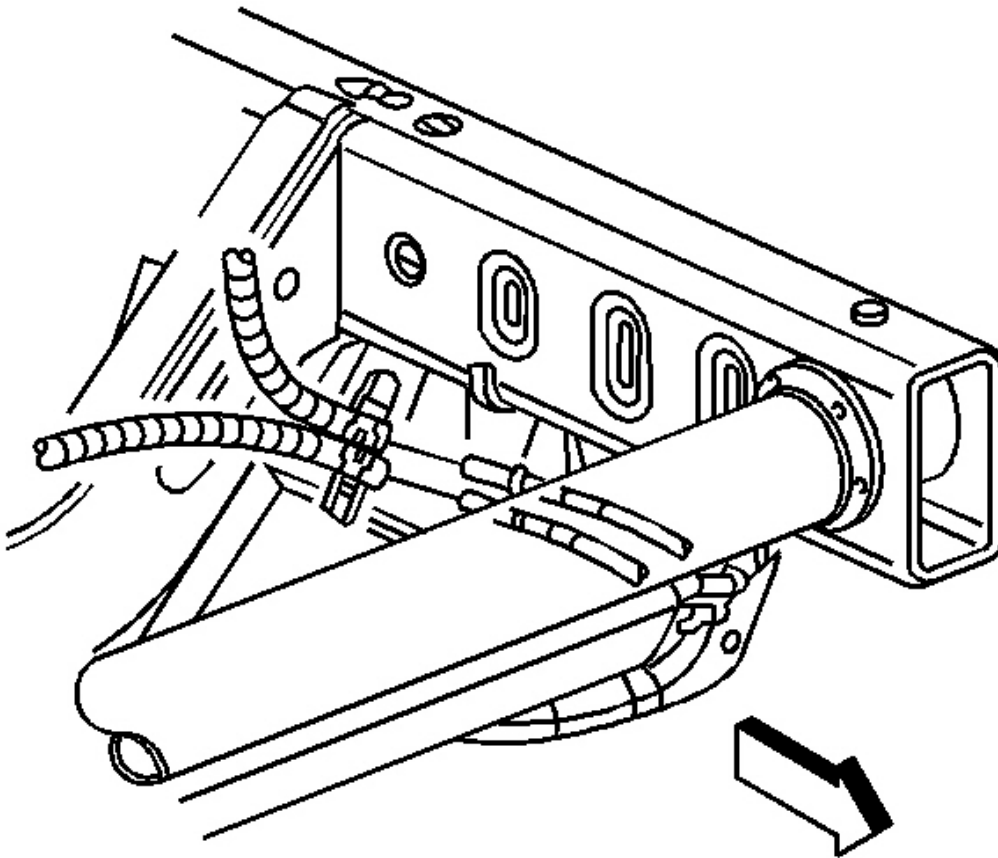
**NOTE:** Refer to **Power Steering Hose Disconnected Notice** .

2. Install the drain pan under the vehicle.



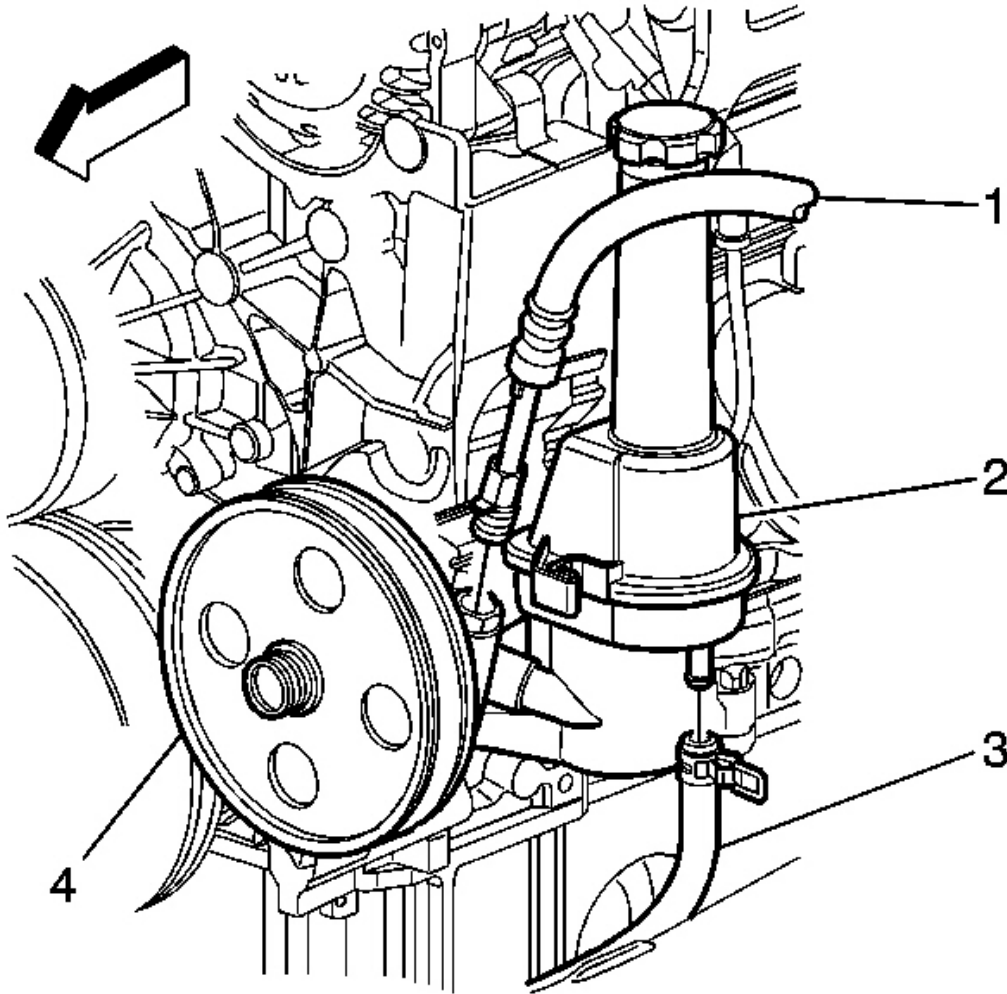
**Fig. 59: View Of Power Steering Hose Assembly, Mounting Bolt & Steering Gear**  
Courtesy of GENERAL MOTORS CORP.

3. Remove power steering hose assembly to power steering gear mounting bolt (2).
4. Disconnect the power steering hose assembly (1) from the power steering gear (3).



**Fig. 60: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

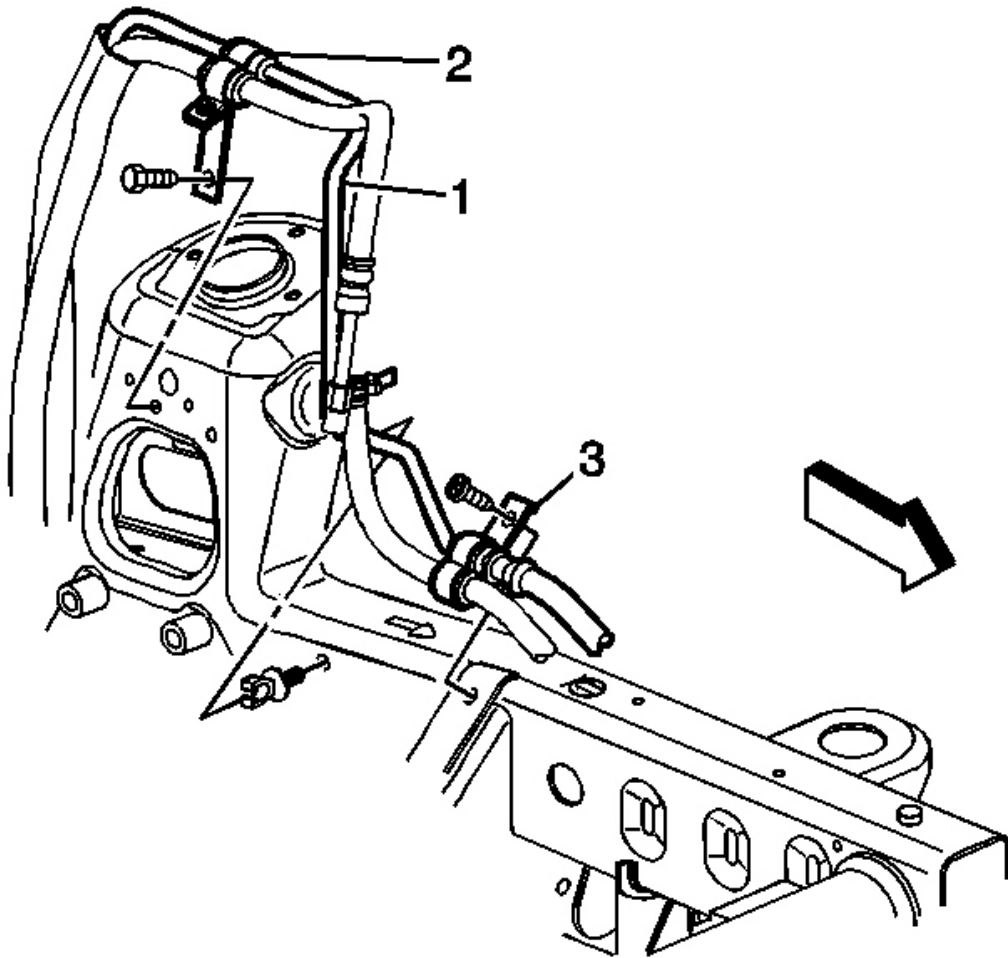
5. Disconnect the power steering return hose and power steering cooler hose from the power steering cooler.
6. Lower the vehicle.



**Fig. 61: View Of Power Steering Pressure Hose, Return Hose & Pump**  
**Courtesy of GENERAL MOTORS CORP.**

7. Disconnect the power steering pressure (1) and return hose (3) from the power steering pump (2).
8. Remove the engine control module (ECM) from the ECM mounting bracket and position the ECM out of the way. Refer to Engine Control Module Replacement .

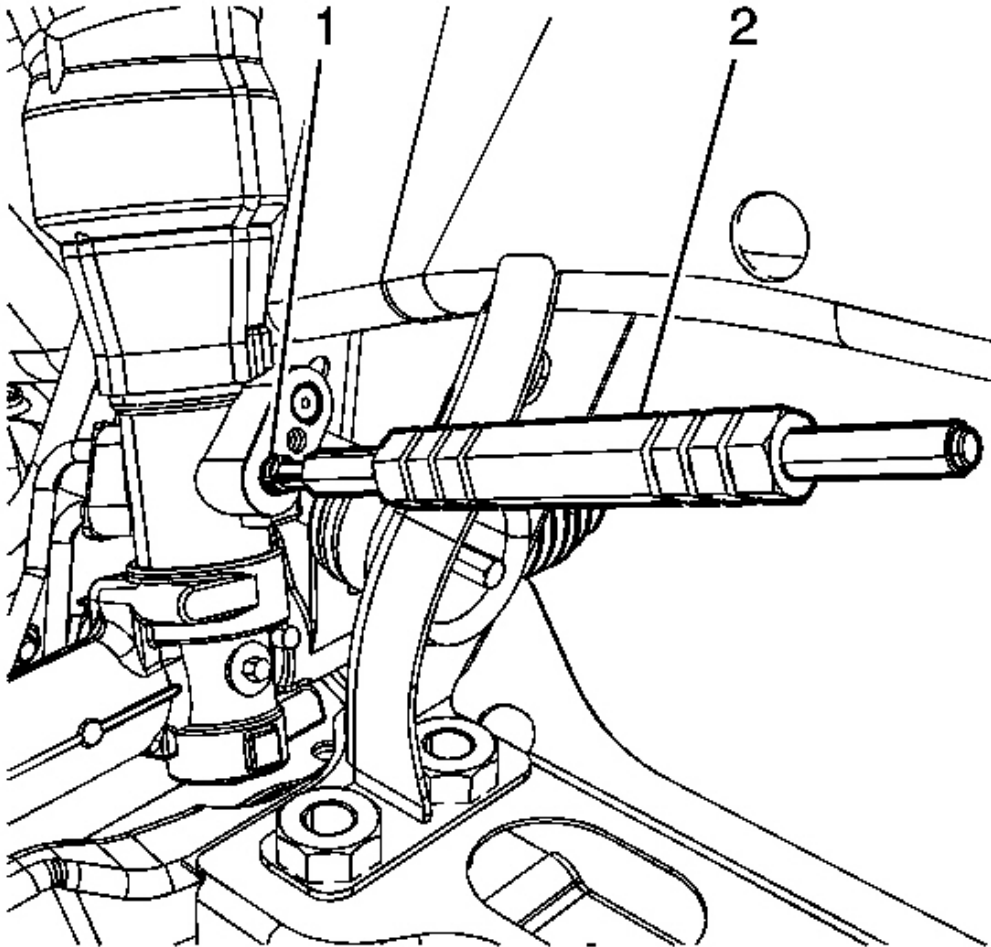




**Fig. 62: View Of Power Steering Hose Assembly, Front Bracket Mounting Bolt & Rear Bracket Mounting Bolt**

Courtesy of GENERAL MOTORS CORP.

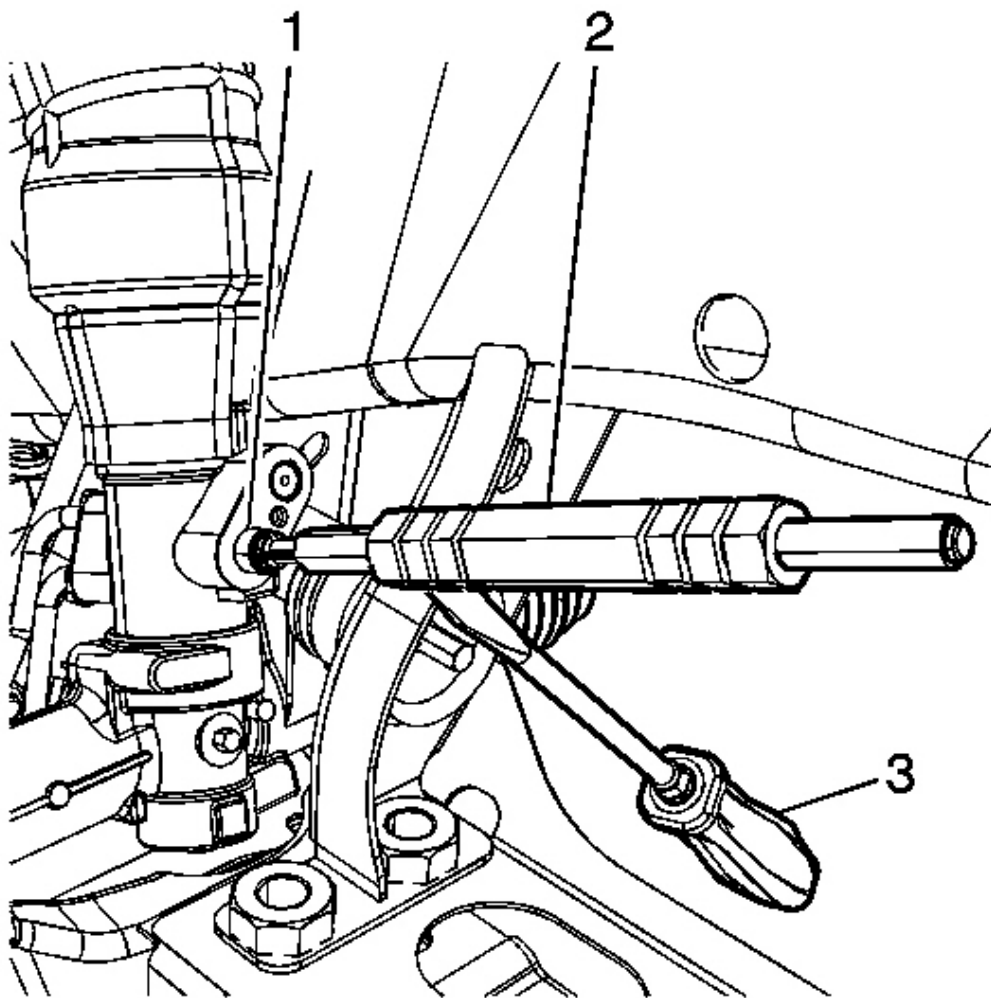
9. Remove the power steering hose assembly (1) front bracket mounting bolt (3) from the frame.
10. Remove the power steering pressure hose from the retaining clip.
11. Remove the power steering hose assembly rear bracket mounting bolt (2).
12. Remove the power steering hose assembly from the vehicle.
13. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .



**Fig. 63: Identifying Seal Extractor J 44586**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Clean the power steering gear inlet and outlet ports thoroughly of any debris. Failure to do so could result in contamination and damage to the power steering system components.

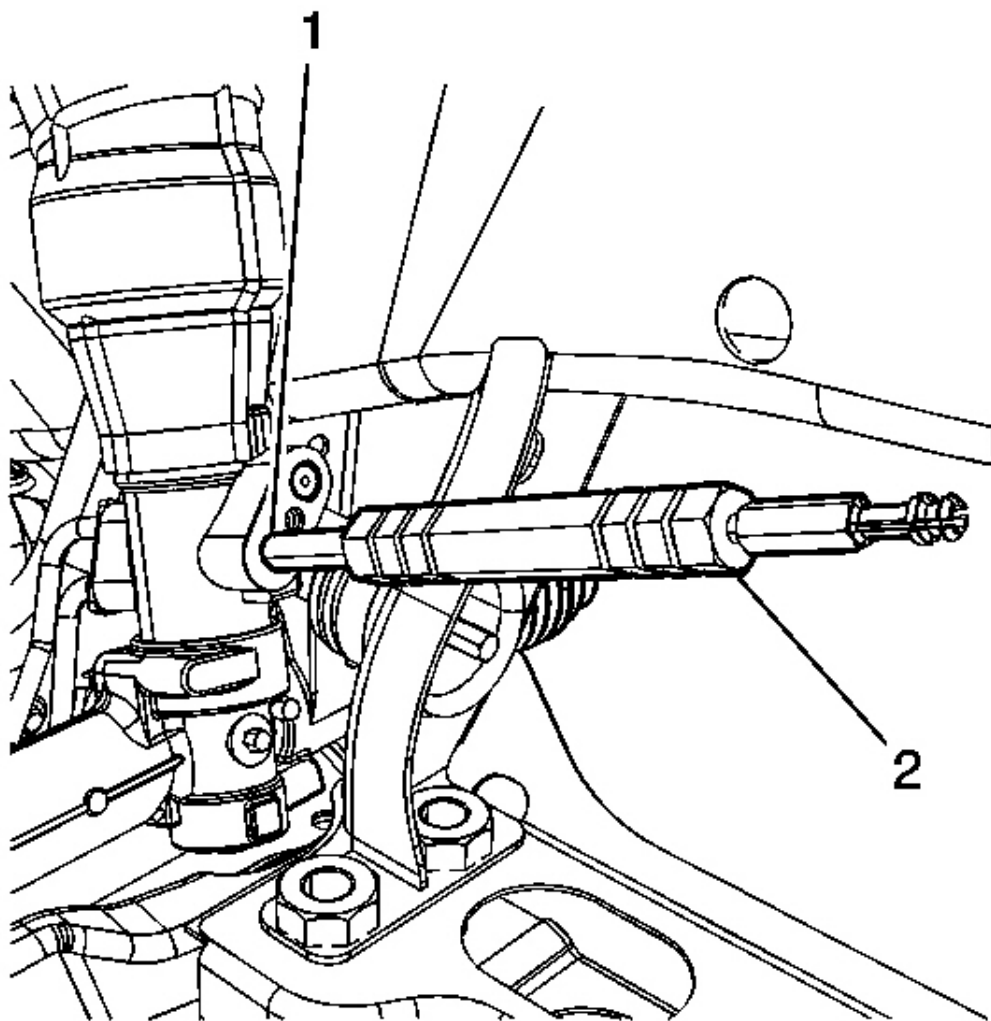
14. Install the seal extraction end of the **J 44586** (2) to the power steering gear oil seal (1). See **Special Tools**.



**Fig. 64: Removing Steering Gear Oil Seal**  
Courtesy of GENERAL MOTORS CORP.

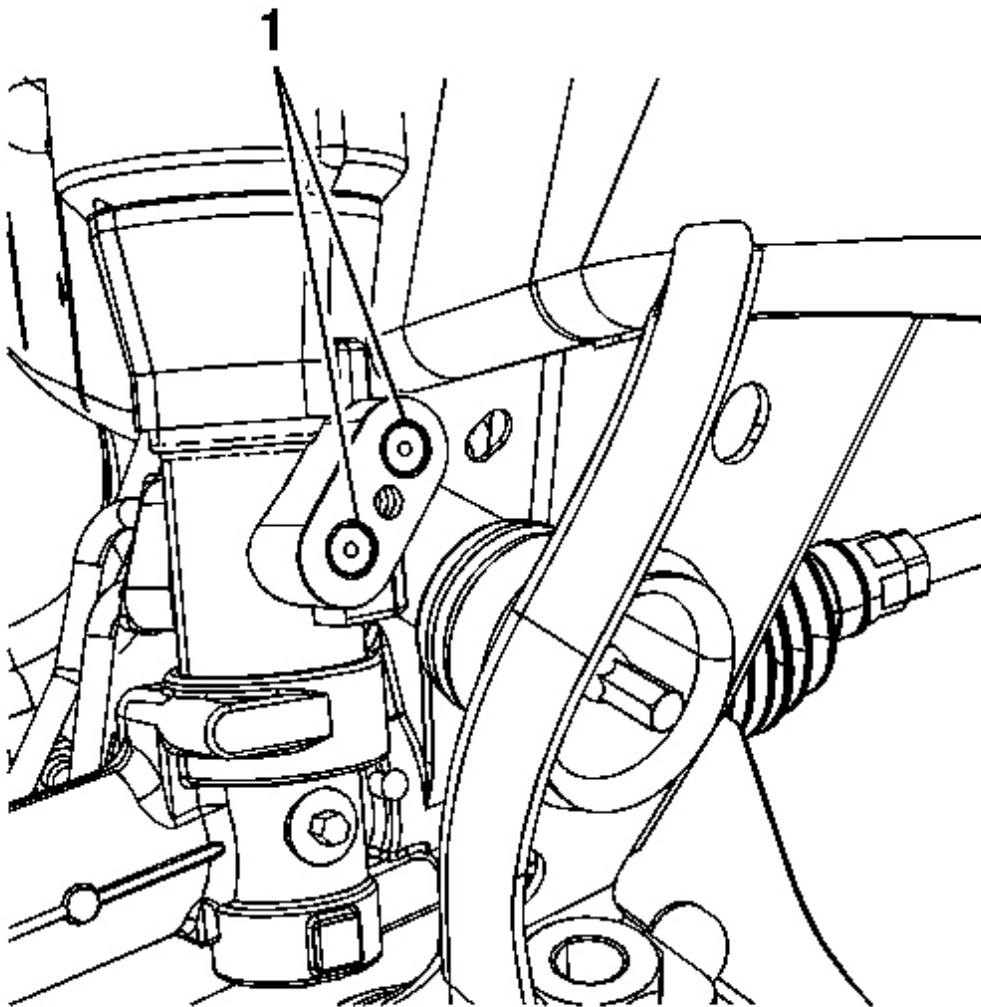
15. Extract the power steering gear oil seal (1) from the power steering gear using the **J 44586** (2) with the aid of a flat-bladed tool (3) for additional leverage. See **Special Tools**.

#### Installation Procedure



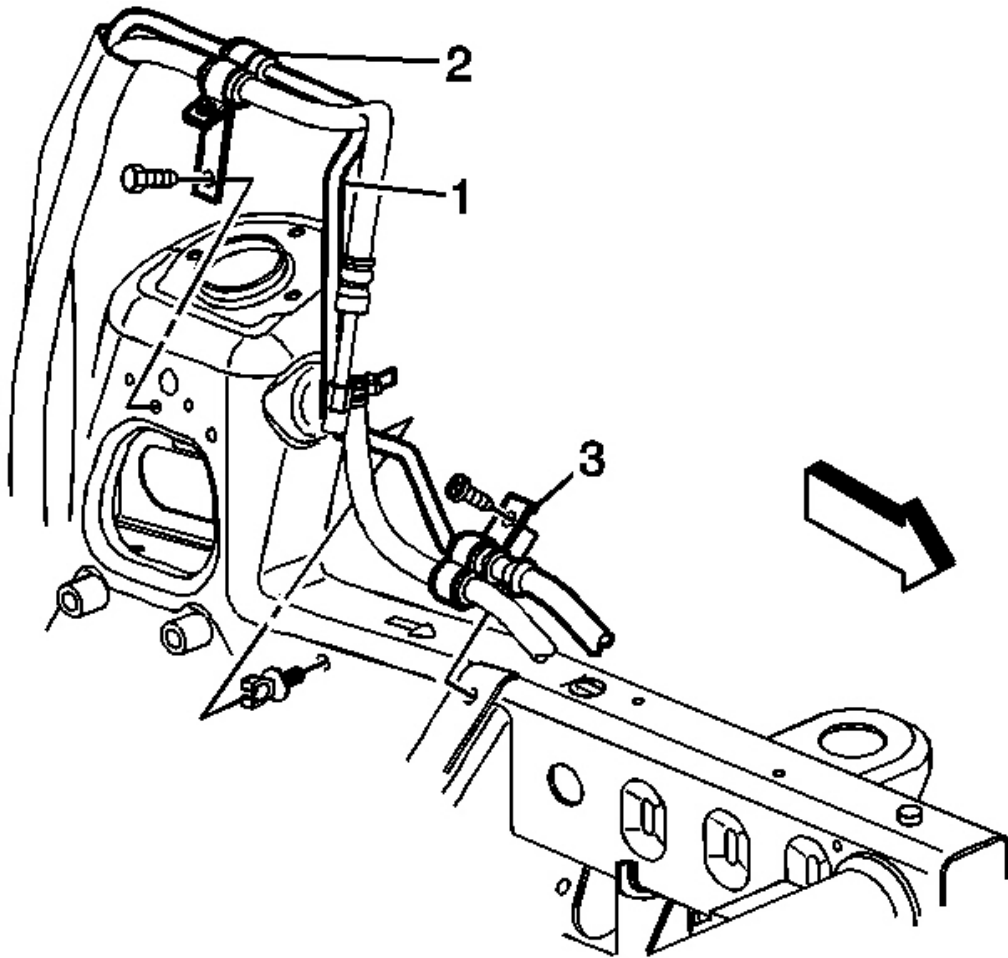
**Fig. 65: Identifying Steering Gear Oil Seal Installer End Of J 44586**  
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW power steering gear oil seal (1) to the power steering gear using the seal installation end of the **J 44586** (2). See **Special Tools**.



**Fig. 66: View Of Power Steering Gear Oil Seals**  
**Courtesy of GENERAL MOTORS CORP.**

2. Ensure the power steering gear oil seals (1) are fully seated in the power steering gear.
3. Lower the vehicle.



**Fig. 67: View Of Power Steering Hose Assembly, Front Bracket Mounting Bolt & Rear Bracket Mounting Bolt**

Courtesy of GENERAL MOTORS CORP.

4. Install the power steering hose assembly (1) to the vehicle.

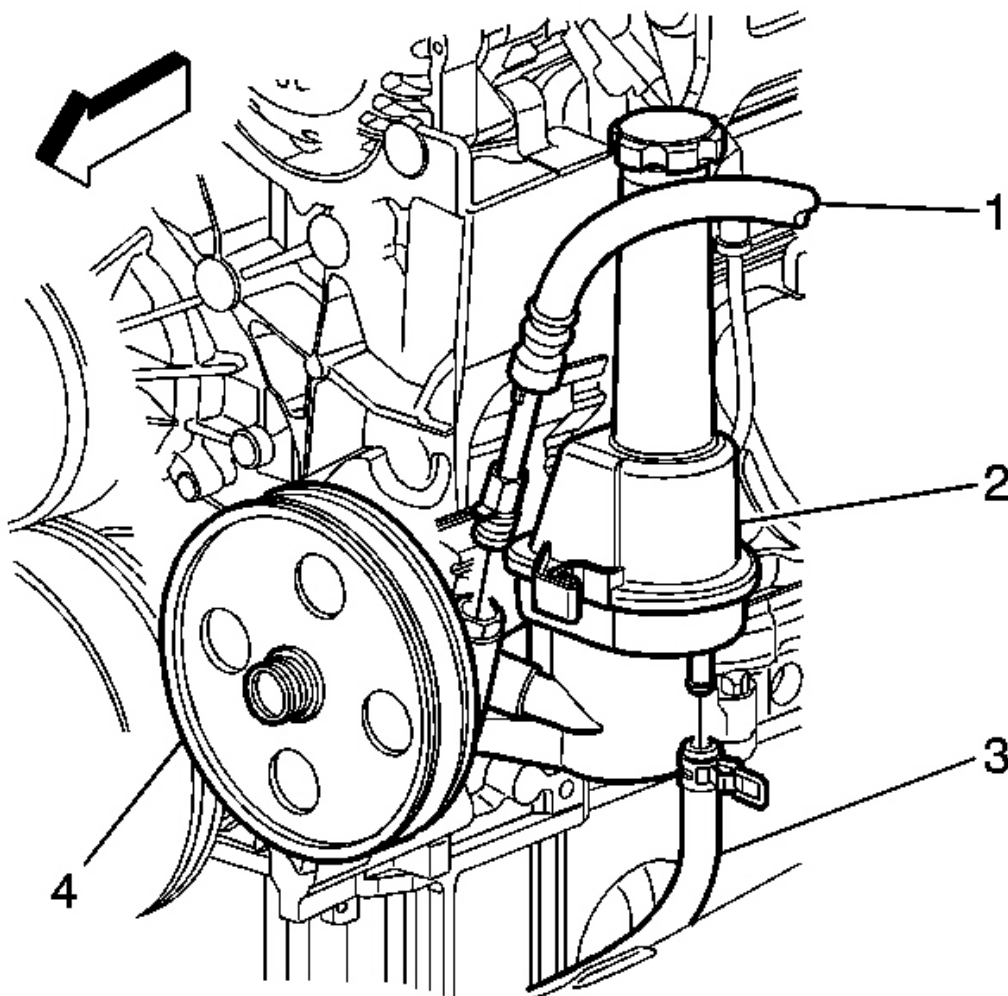
**NOTE:** Refer to Fastener Notice .

5. Install the power steering hose assembly rear bracket (2) mounting bolt.

**Tighten:** Tighten the bolt to 10 N.m (89 lb in).

6. Install the power steering pressure hose retaining clip.

7. Install the power steering hose assembly front bracket mounting bolt (3).



**Fig. 68: View Of Power Steering Pressure Hose, Return Hose & Pump**  
Courtesy of GENERAL MOTORS CORP.

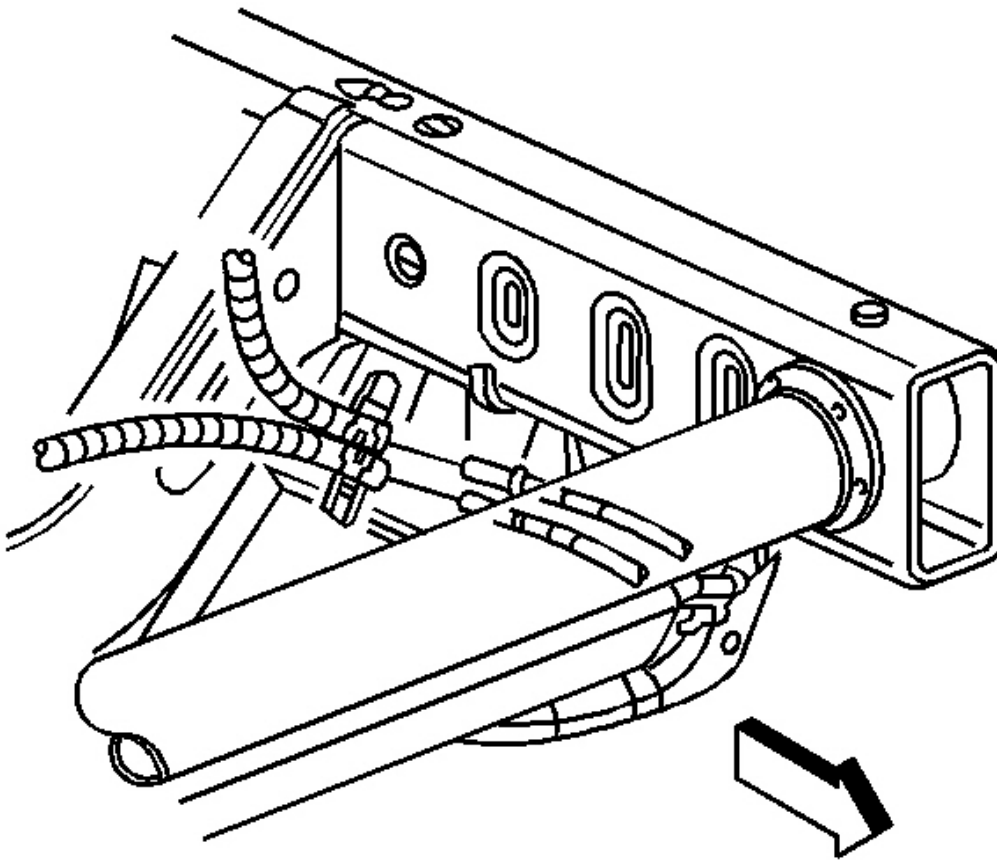
8. Install the power steering cooler hose (3) to the power steering pump (2).

**NOTE:** Refer to **Component Fastener Tightening Notice** .

9. Connect the power steering pressure (1) to the power steering pump (2).

**Tighten:** Tighten the power steering pressure hose fitting to 25 N.m (18 lb in).

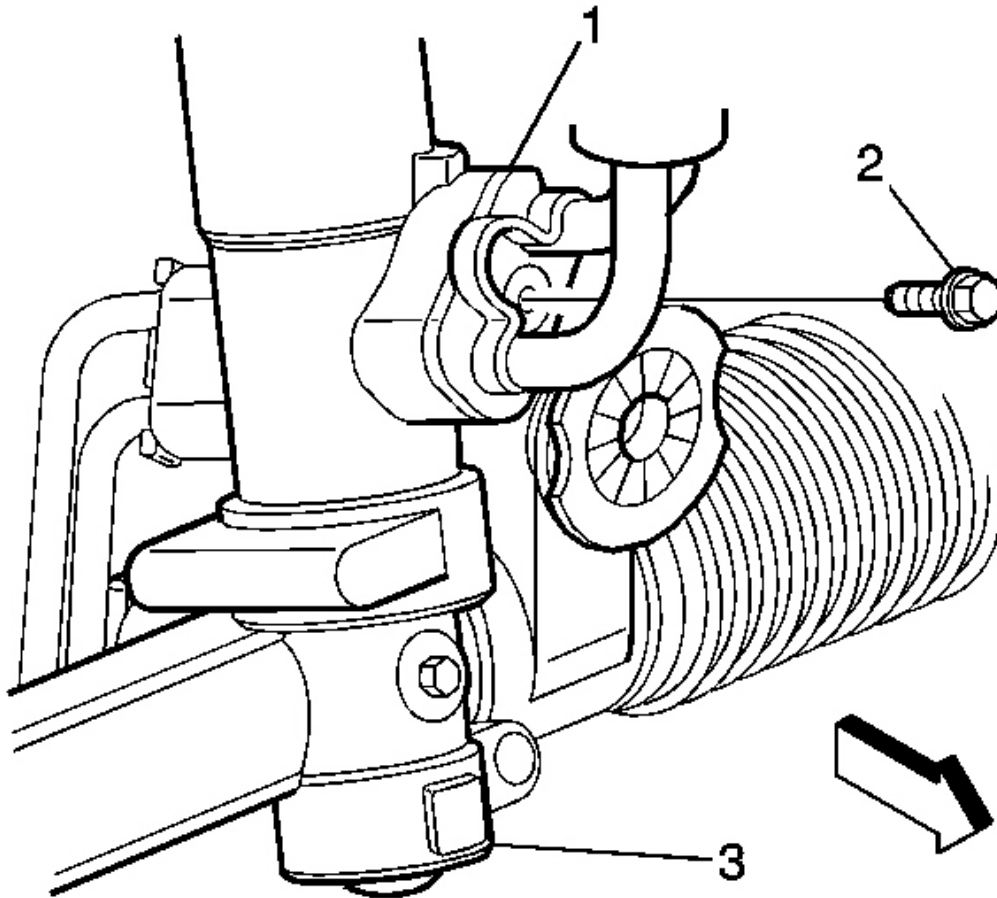
10. Install the ECM to the ECM mounting bracket. Refer to Engine Control Module Replacement .
11. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .



**Fig. 69: View Of Power Steering Hose Assembly At Power Steering Cooler**  
Courtesy of GENERAL MOTORS CORP.

12. Install the power steering return hose and the power steering cooler hose to the power steering cooler.





**Fig. 70: View Of Power Steering Hose Assembly, Mounting Bolt & Steering Gear**  
Courtesy of GENERAL MOTORS CORP.

13. Connect the power steering hose assembly (1) to the power steering gear (3).
14. Install the power steering hose assembly to the power steering gear with the mounting bolt (2).

**Tighten:** Tighten the bolt to 12 N.m (106 lb in).

15. Remove the drain pan from under the vehicle.
16. Lower the vehicle.
17. Bleed the power steering system. Refer to **Power Steering System Bleeding**.

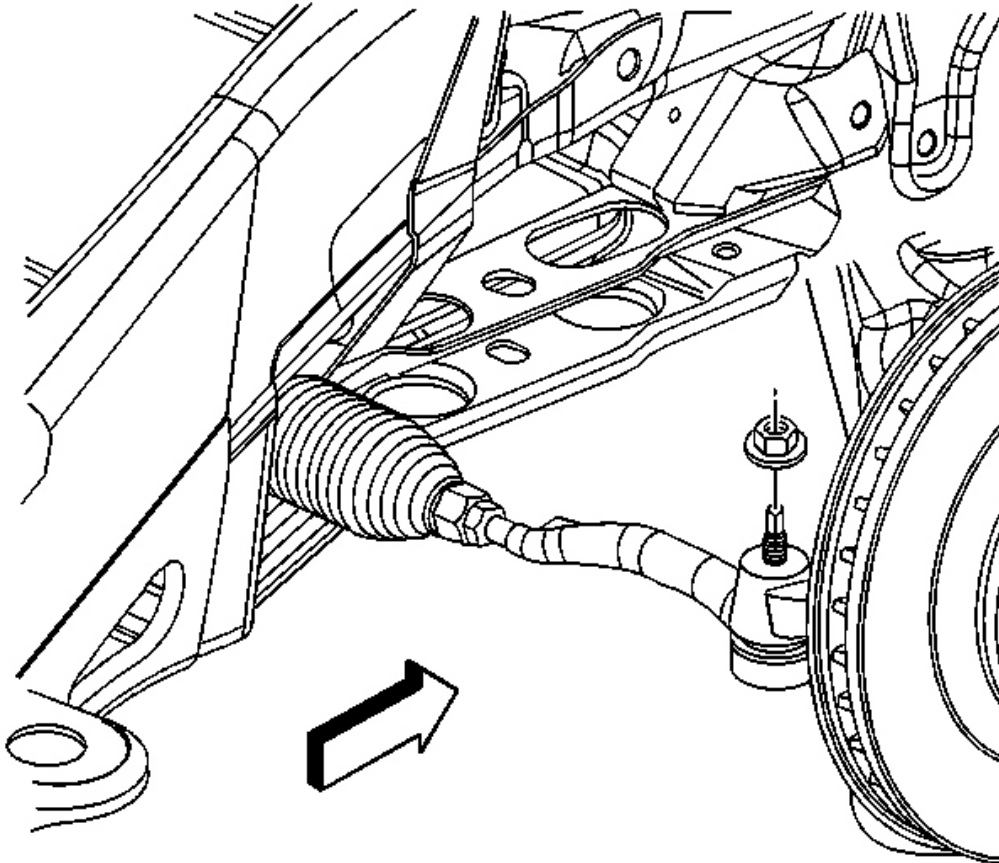
## STEERING GEAR REPLACEMENT

### Special Tools

**J 24319-B** Steering Linkage and Tie Rod Puller. See Special Tools.

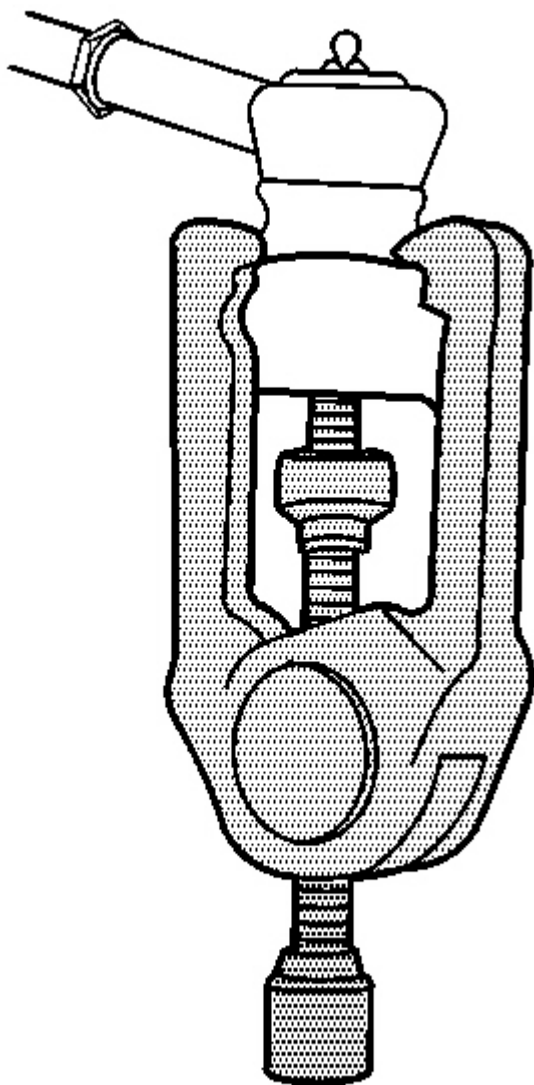
### Removal Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Install a drain pan under the vehicle.
3. Remove the tires and wheels. Refer to Tire and Wheel Removal and Installation .



**Fig. 71: View Of Tie Rod Retaining Nut**  
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the outer tie rod retaining nuts.

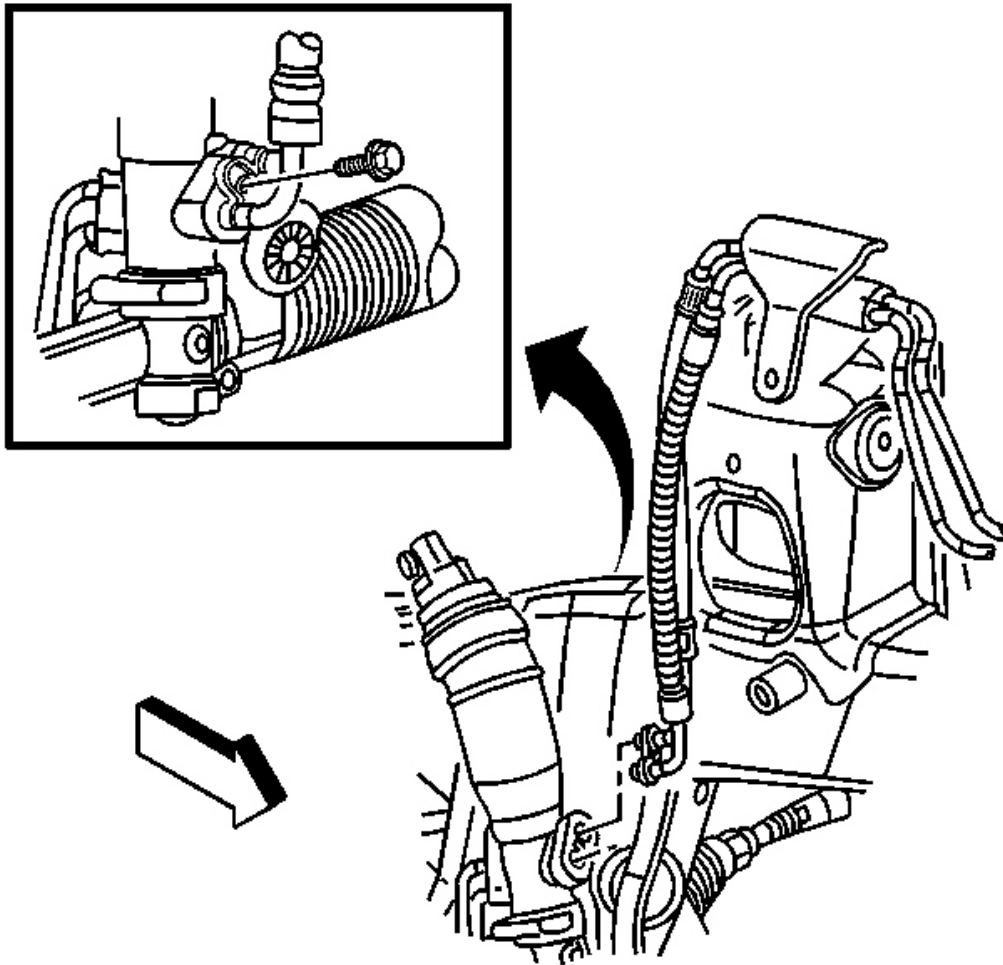


**Fig. 72: View Of Outer Tie Rod Assembly & J 24319-B**  
Courtesy of GENERAL MOTORS CORP.

**NOTE:** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

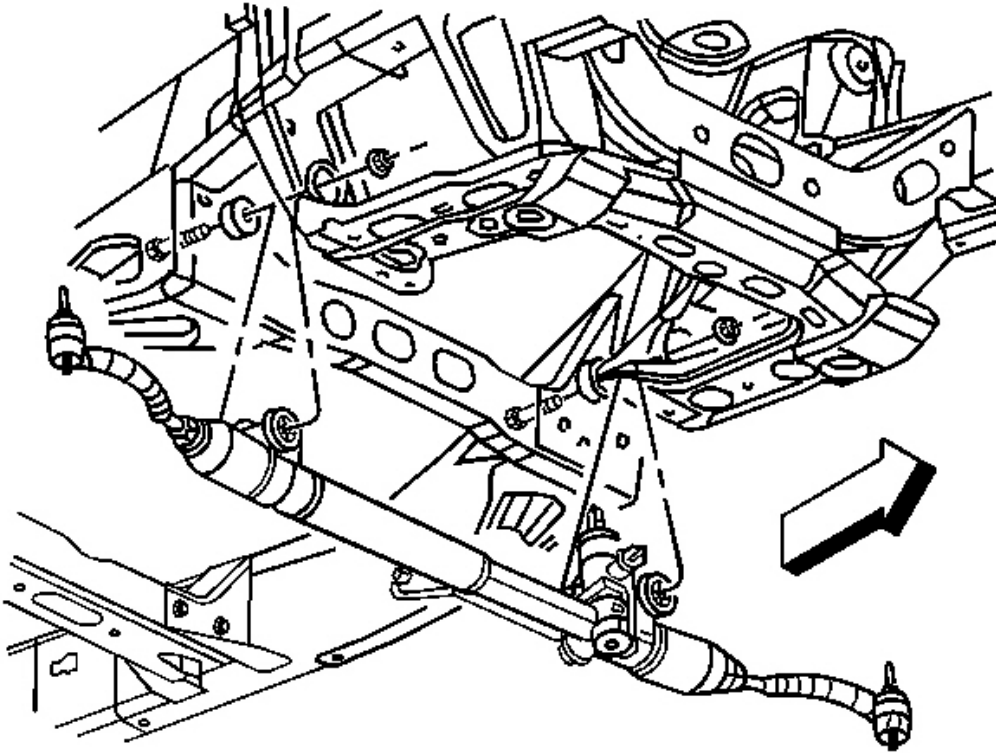
5. Disconnect the outer tie rods from the steering knuckles using **J 24319-B** . See **Special Tools**.

6. Remove the steering gear crossmember. Refer to **Front Steering Gear Crossmember Replacement**.
7. Disconnect the lower intermediate shaft from the power steering gear. Refer to **Lower Intermediate Steering Shaft Replacement**.



**Fig. 73: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the power steering hose assembly to the power steering gear retaining bolt.
9. Remove the power steering hose assembly from the power steering gear.
10. Support the power steering gear.

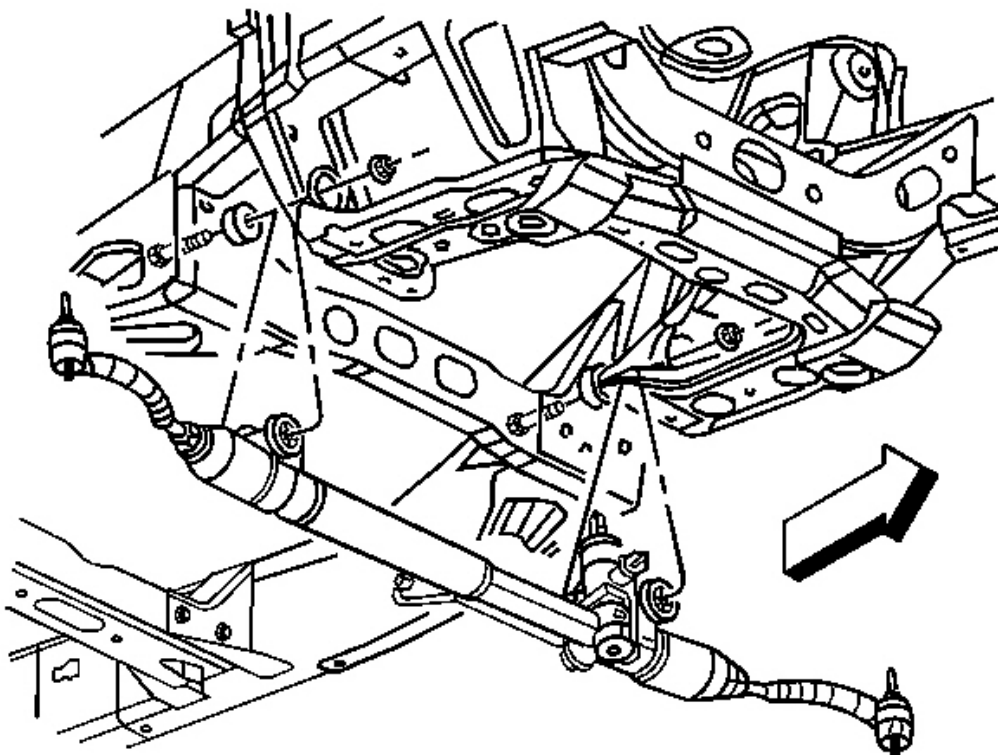


**Fig. 74: View Of Power Steering Gear & Bolts**  
Courtesy of GENERAL MOTORS CORP.

11. Remove the power steering gear mounting bolts.
12. Remove the power steering gear from the vehicle.
13. Remove the outer tie rods from the inner tie rods. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

#### **Installation Procedure**

1. Install the outer tie rods. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.



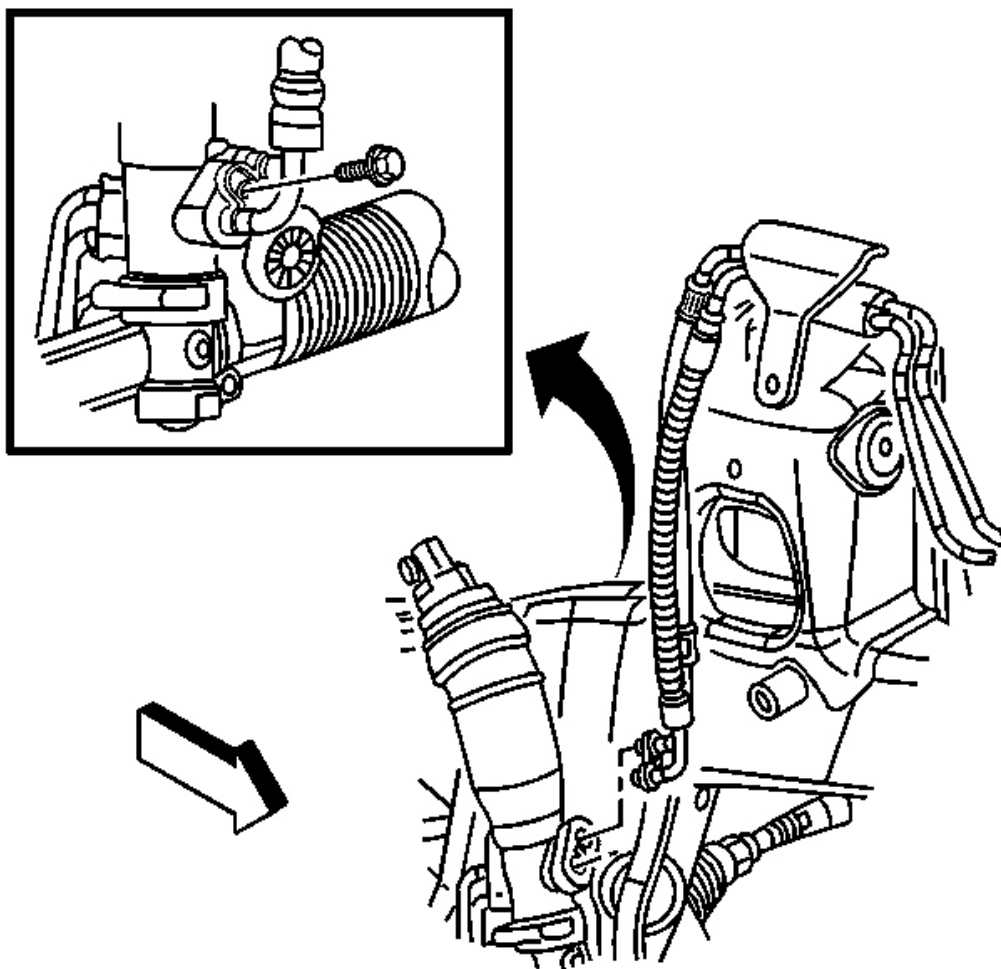
**Fig. 75: View Of Power Steering Gear & Bolts**  
Courtesy of GENERAL MOTORS CORP.

2. Install the power steering gear to the vehicle.

**NOTE:** Refer to Fastener Notice .

3. Install the power steering gear mounting bolts.

**Tighten:** Tighten the power steering gear mounting bolts to 110 N.m (81 lb ft).



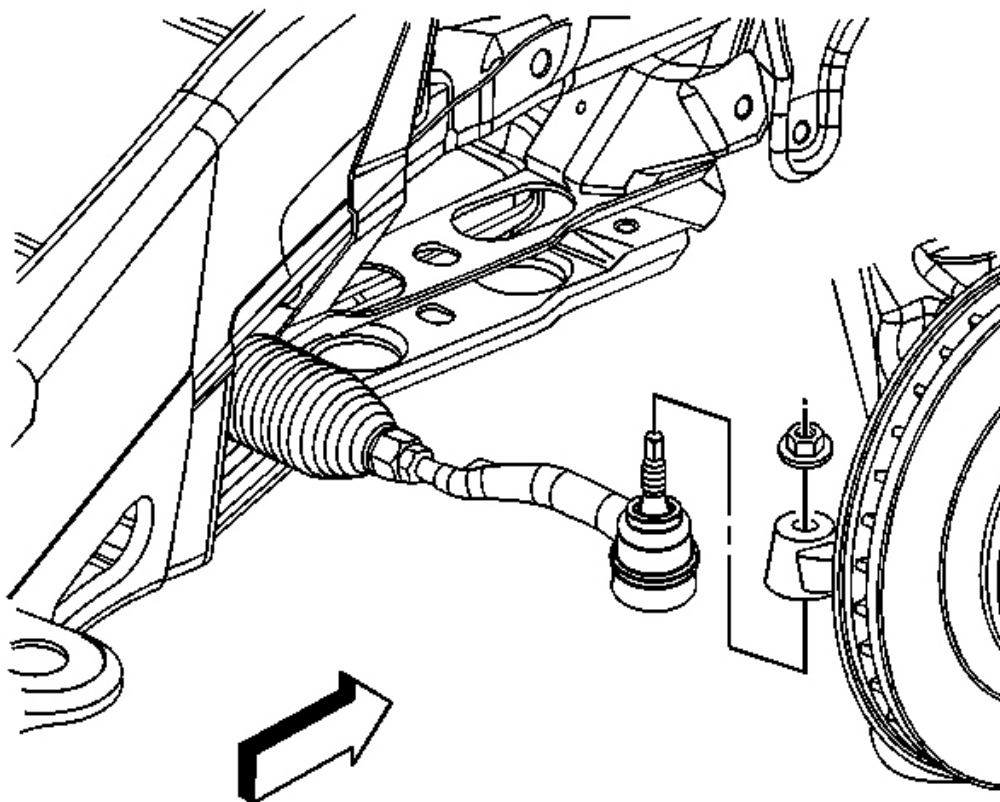
**Fig. 76: View Of Power Steering Hose Assembly To Gear Retaining Bolt**  
**Courtesy of GENERAL MOTORS CORP.**

4. Remove the support from the power steering gear.
5. Install the power steering hose assembly to the power steering gear.
6. Install the power steering hose assembly to the power steering gear retaining bolt.

**Tighten:** Tighten the power steering hose assembly to power steering gear retaining bolt to 12 N.m (106 lb in).

7. Connect the lower intermediate shaft to the power steering gear. Refer to **Lower Intermediate Steering Shaft Replacement** .

8. Install the steering gear crossmember. Refer to **Front Steering Gear Crossmember Replacement** .



**Fig. 77: View Of Tie Rod & Steering Knuckle**  
Courtesy of GENERAL MOTORS CORP.

9. Connect the outer tie rods to the steering knuckles.
10. Install the new outer tie rod retaining nuts.

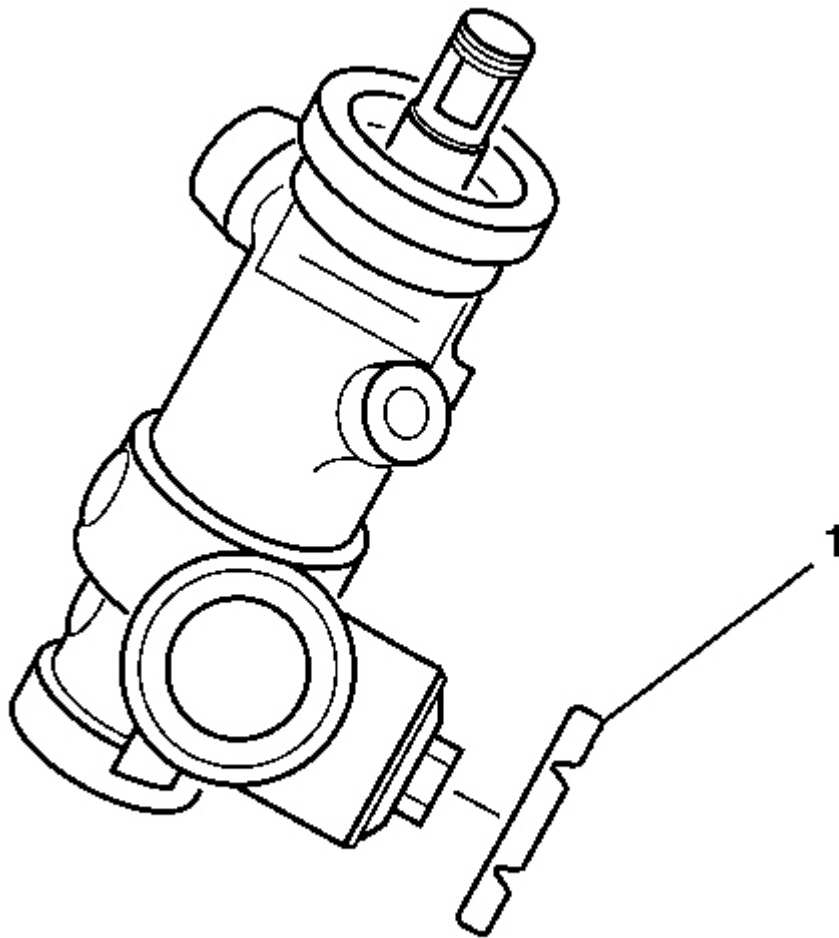
**Tighten:** Tighten the outer tie rods retaining nuts to 57 N.m (42 lb ft).

11. Install the tires and wheels. Refer to **Tire and Wheel Removal and Installation** .
12. Remove the drain pan from under the vehicle.
13. Lower the vehicle.
14. Bleed the power steering system. Refer to **Power Steering System Bleeding**.
15. It is not necessary to adjust the front toe unless a tie rod end or the steering gear has been replaced. Refer to **Front Toe Adjustment** .



16. Lower the vehicle.

**STEERING GEAR RACK BEARING PRELOAD ADJUSTMENT - OFF VEHICLE**



**Fig. 78: View Of Adjuster Plug Lock Nut (Rack & Pinion)**  
**Courtesy of GENERAL MOTORS CORP.**

1. Loosen the adjuster plug lock nut (1).
2. Turn the adjuster plug clockwise until the adjuster plug bottoms in the gear assembly.
3. Turn the adjuster plug back 50 degrees to 70 degrees, approximately one flat.

**NOTE:** Refer to Fastener Notice .

4. Install the adjuster plug lock nut (1) to the adjuster plug.

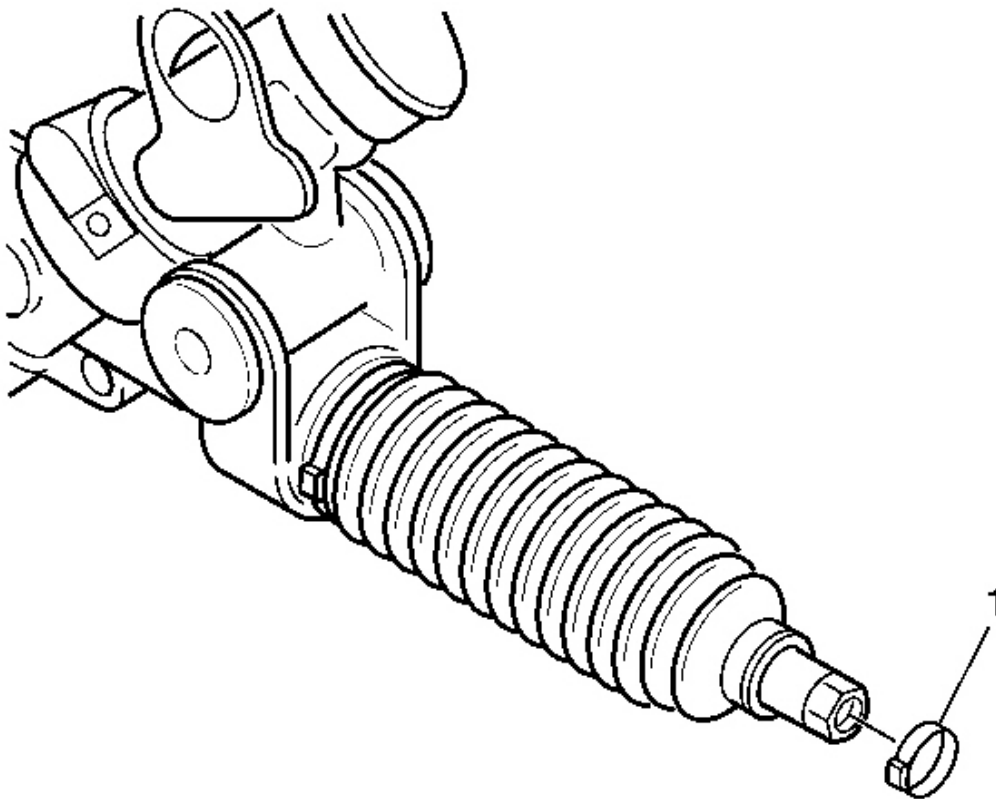
**Tighten:** Hold the adjuster plug stationary while tightening the adjuster plug lock nut (1) to 75 N.m (55 lb ft).

## STEERING GEAR BOOT REPLACEMENT - OFF VEHICLE

### Tools Required

**J 22610** Keystone Clamp Pliers

### Removal Procedure

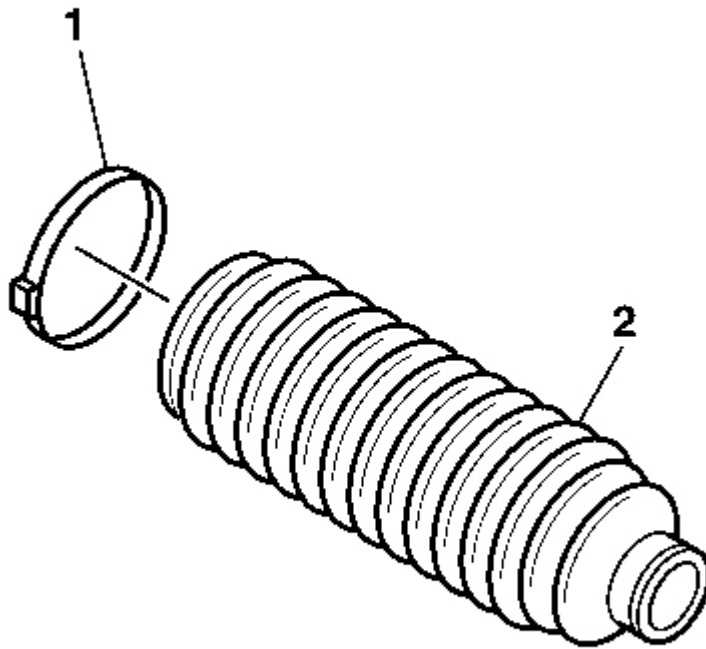


**Fig. 79: Identifying Small Boot Retaining Clamp**  
Courtesy of GENERAL MOTORS CORP.

1. Remove the outer tie rod. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.
2. Remove the rack and pinion gear. Refer to **Steering Gear Replacement**.

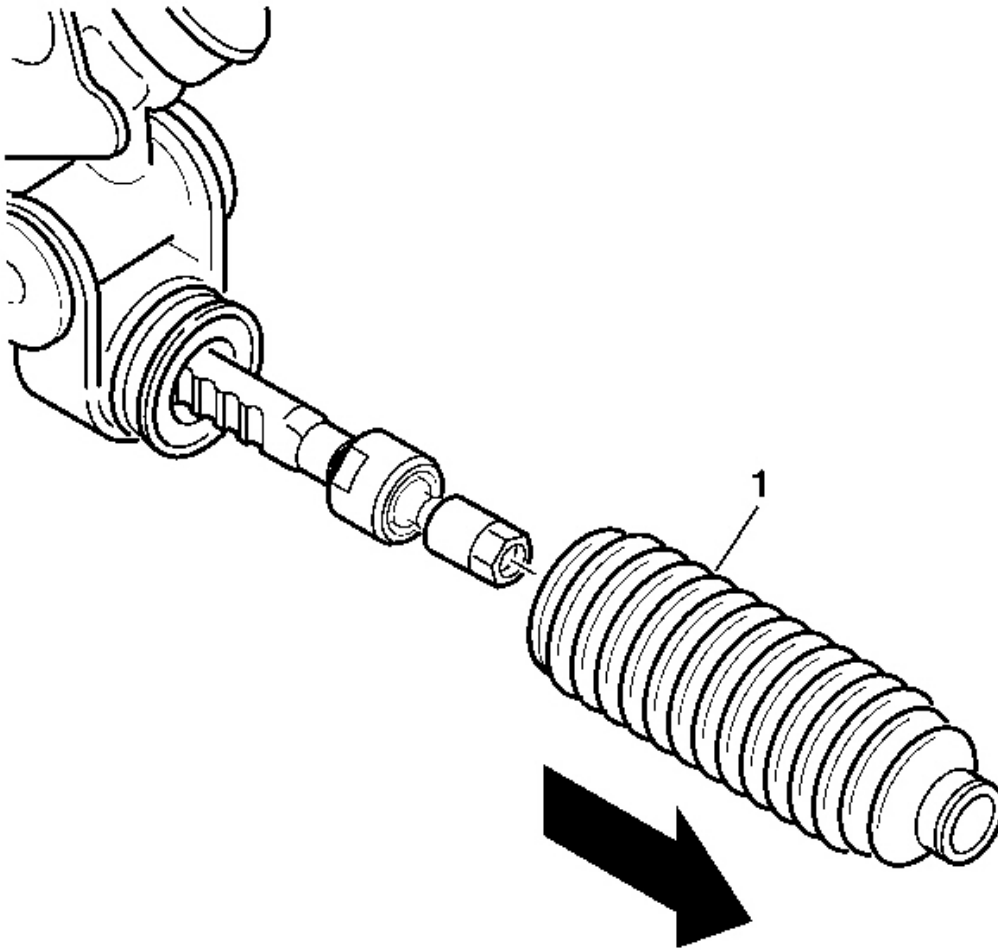
**IMPORTANT: All boot parts must be replaced when replacing the inner tie rod.**

3. Remove and discard the small seal retaining clamp (1).



**Fig. 80: View Of Large Boot Retaining Clamp**  
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the large seal retaining clamp (1) from the rack and pinion boot (2) with side cutters.



**Fig. 81: View Of Rack & Pinion Boot & Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

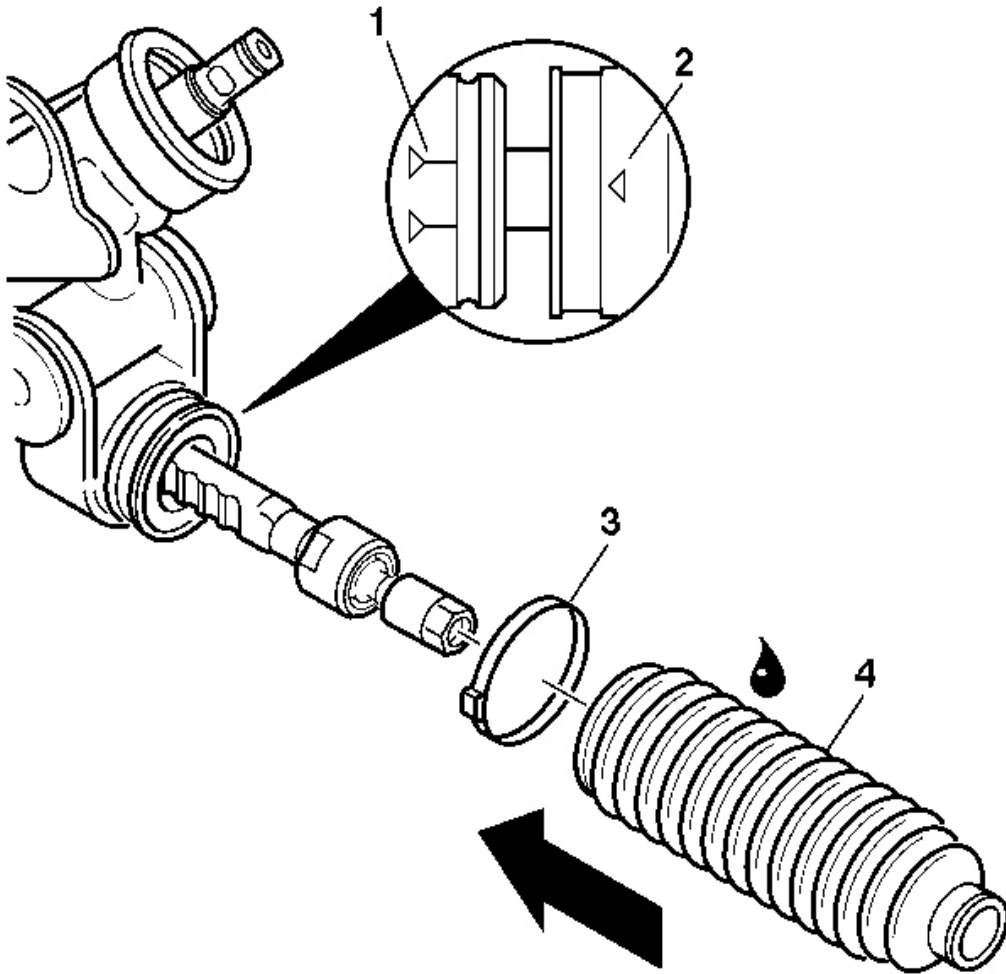
**IMPORTANT:**

- Do not cut the end of the boot or place a screwdriver between boot and tie rod.
- After removing the boot, inspect the inner tie rod for evidence of corrosion or contamination. If none is evident, continue with the repair. If corrosion or contamination is evident, replace the steering gear.

5. Firmly pull rack and pinion boot (1) from the gear.

Discard the rack and pinion boot (1).

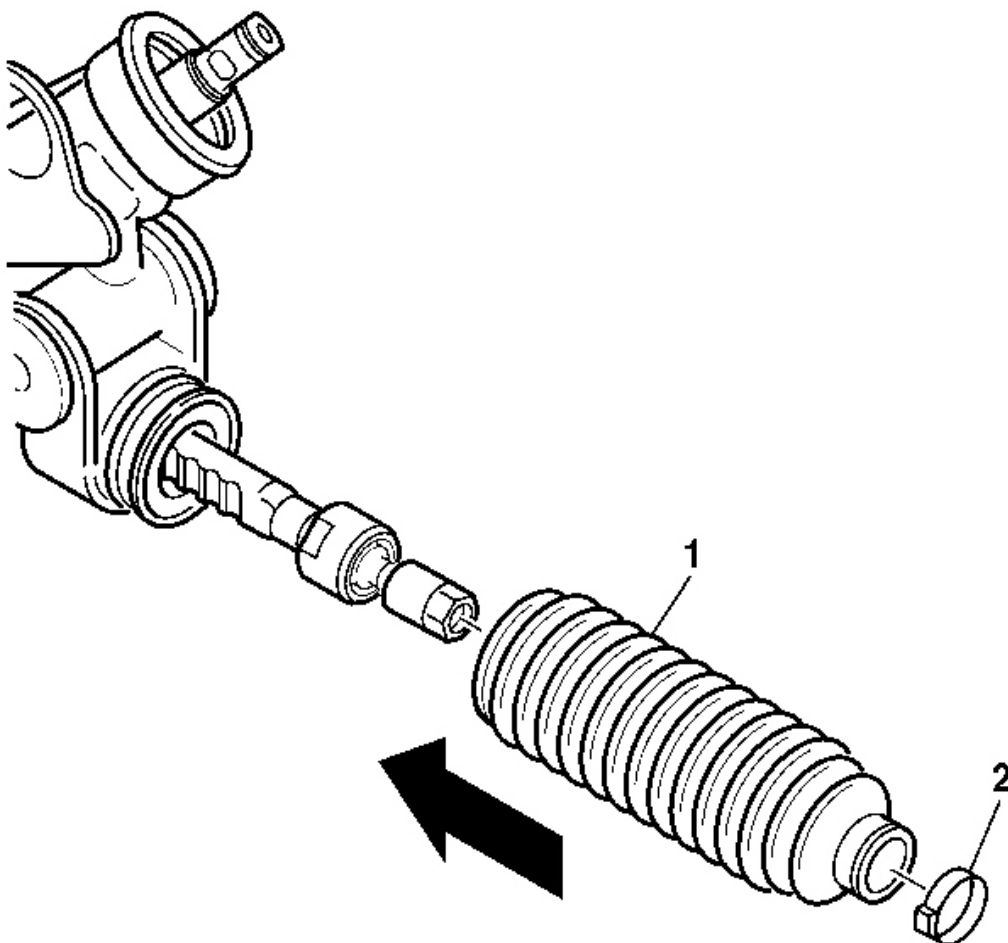
## Installation Procedure



**Fig. 82: Identifying Boot & Inner Rod End Alignment Arrows**  
Courtesy of GENERAL MOTORS CORP.

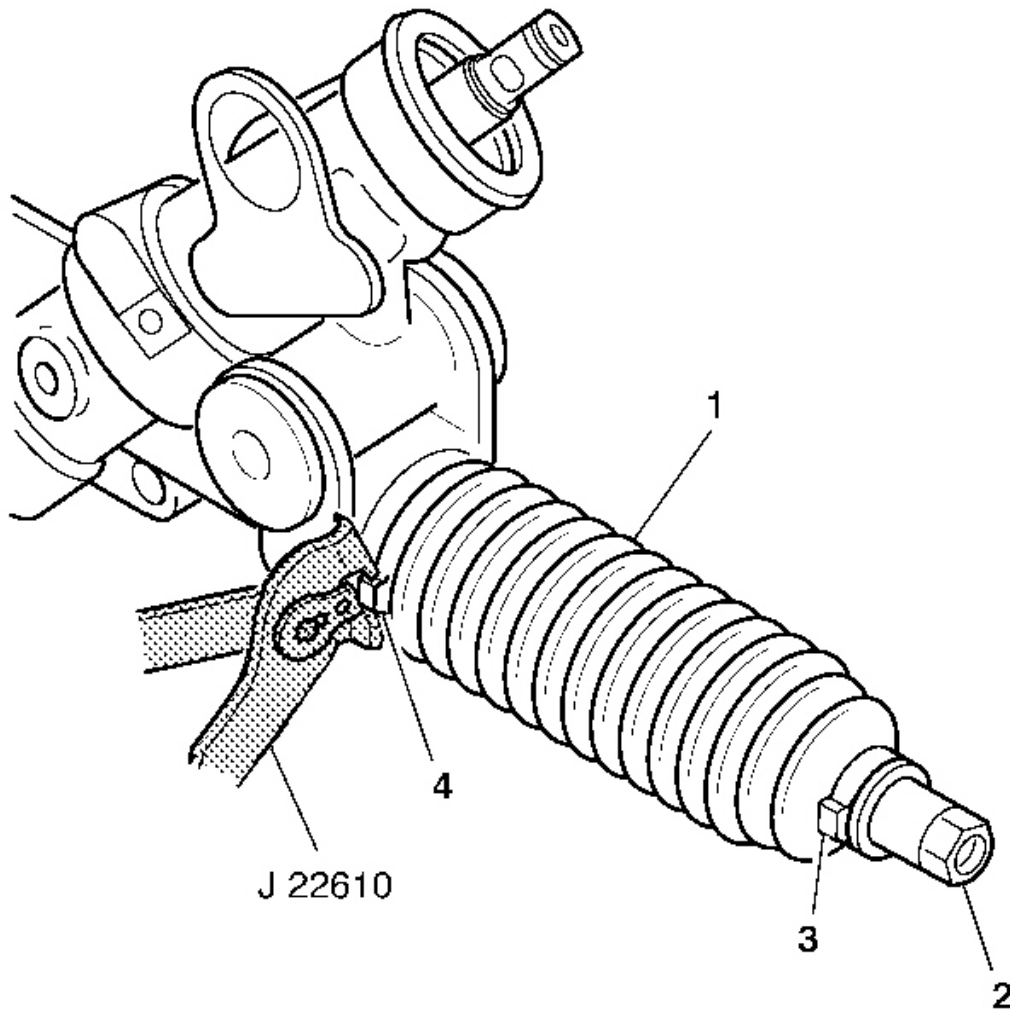
**IMPORTANT:** The arrows (2) on the boot must be aligned with the range (1) on the gear housing.

1. Apply grease provided to inside of rack and pinion boot ribs (4).
2. Place the new large seal retaining clamp (3) onto rack and pinion boot (4).
3. Install boot (4) over inner tie rod end. Align the arrows (2) on boot (4) with the range (1) marked on the gear housing.



**Fig. 83: View Of Boot & Inner Tie Rod End**  
Courtesy of GENERAL MOTORS CORP.

4. Install the new small seal retaining clamp (2) over the boot (1).
5. Slide the boot (1) towards the center of the gear assembly until the boot seats in the inner tie rod retaining groove.



**Fig. 84: Crimping Large & Small Seal Retaining Clamps**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** The boot (1) must not be twisted, puckered or out of shape in any way. If the rack and pinion boot (1) is not shaped properly, adjust by hand before installing the boot clamps (3,4). Be sure arrows on the boot (1) align with range on the gear housing.

6. Crimp the large seal retaining clamp (4) on boot (1) with **J 22610** .
7. Crimp the small seal retaining clamp (3) to inner tie rod assembly (2) with **J 22610** .
8. Install the rack and pinion gear. Refer to **Steering Gear Replacement**.

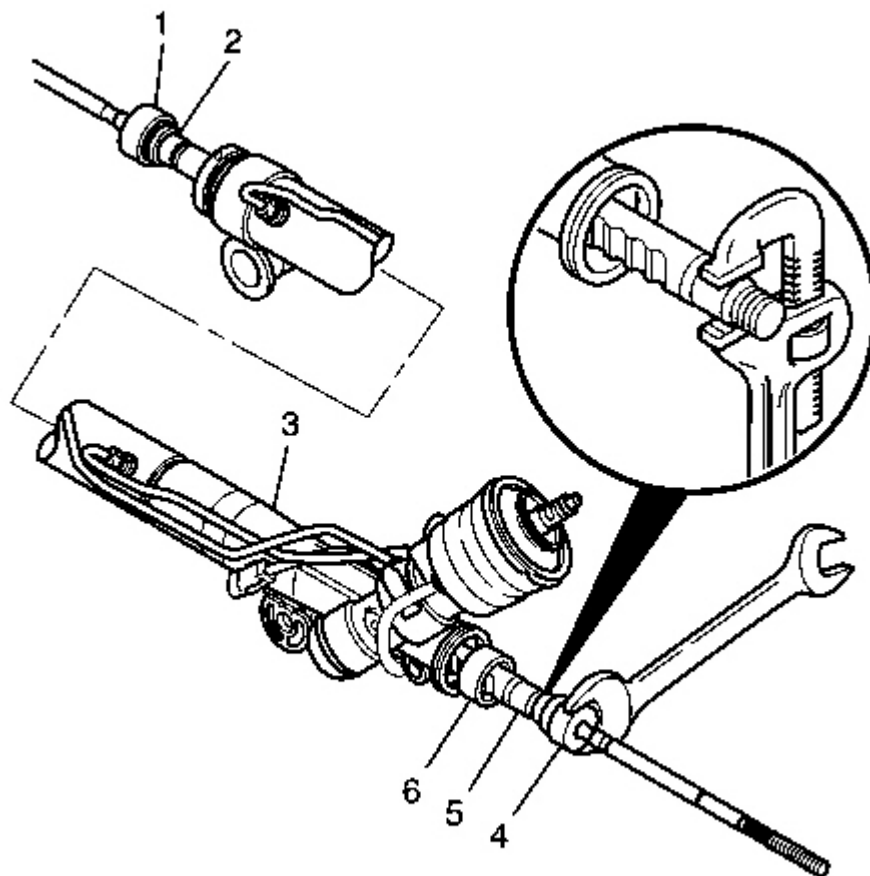
9. Install the outer tie rod. Refer to **Rack and Pinion Outer Tie Rod End Replacement**.

## **STEERING GEAR INNER TIE ROD REPLACEMENT - OFF VEHICLE (MAGNASTEER)**

### **Tools Required**

**J 34028** Inner Tie Rod Wrench. See **Special Tools**.

### **Disassembly Procedure**



**Fig. 85: View of Shock Dampener, Inner Tie Rod Housing & Rack**  
**Courtesy of GENERAL MOTORS CORP.**

1. To remove the rack and pinion boot. Refer to **Steering Gear Boot Replacement - Off Vehicle**.



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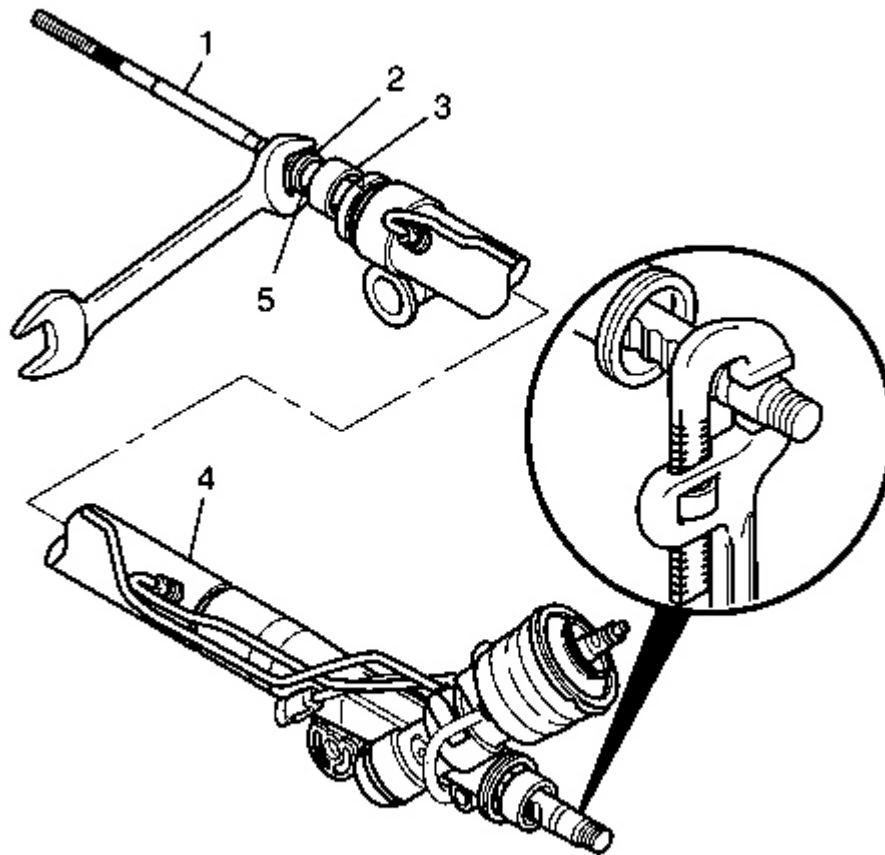
2. Place the gear in a vise.

**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

3. Remove the shock dampener (6) from the inner tie rod housing (4).
4. Slide the shock dampener (6) back on the rack (5).

**NOTE:** The pipe wrench must be placed at the valve end of the steering gear and positioned up against the inner tie rod housing. Placing the pipe wrench in any other location will cause damage to the steering gear.

5. Place a pipe wrench on the rack (5) next to the inner tie rod housing (4).
6. Place a wrench on the flats of the inner tie rod housing (4).
7. Rotate the inner tie rod housing (4) counterclockwise, while holding the rack stationary, until the inner tie rod separates from the rack (5).

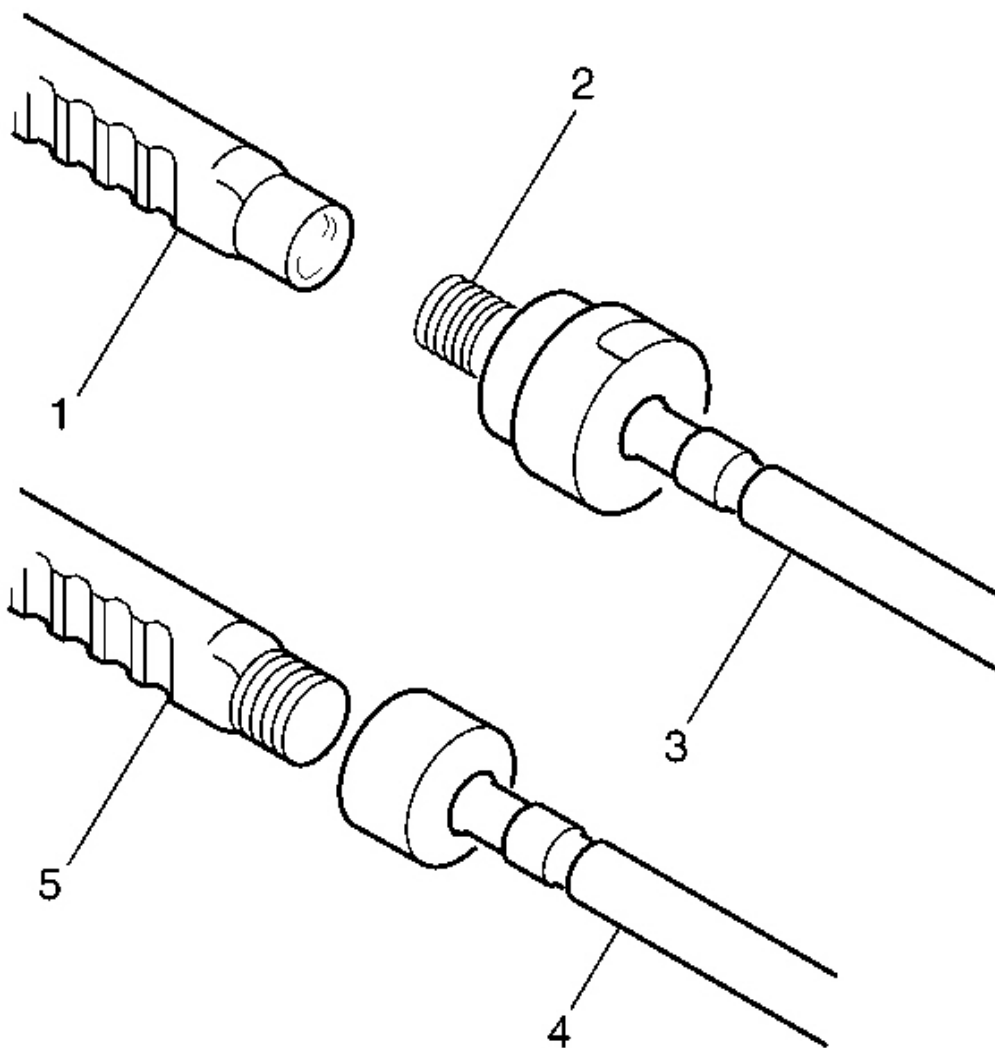


**Fig. 86: View of Shock Dampener, Inner Tie Rod Housing, Rack & Inner Tie Rod**  
Courtesy of GENERAL MOTORS CORP.

8. Remove the shock dampener (3) from the inner tie rod housing (2).
9. Slide the shock dampener (3) back on the rack (5).

**NOTE:** Refer to Pipe Wrench Positioning Notice .

10. Place a pipe wrench on the rack.
11. Place a wrench on the flats of the inner tie rod housing (2).
12. Rotate the inner tie rod housing (2) counterclockwise, while holding the rack stationary, until the inner tie rod (1) separates from the rack (5).

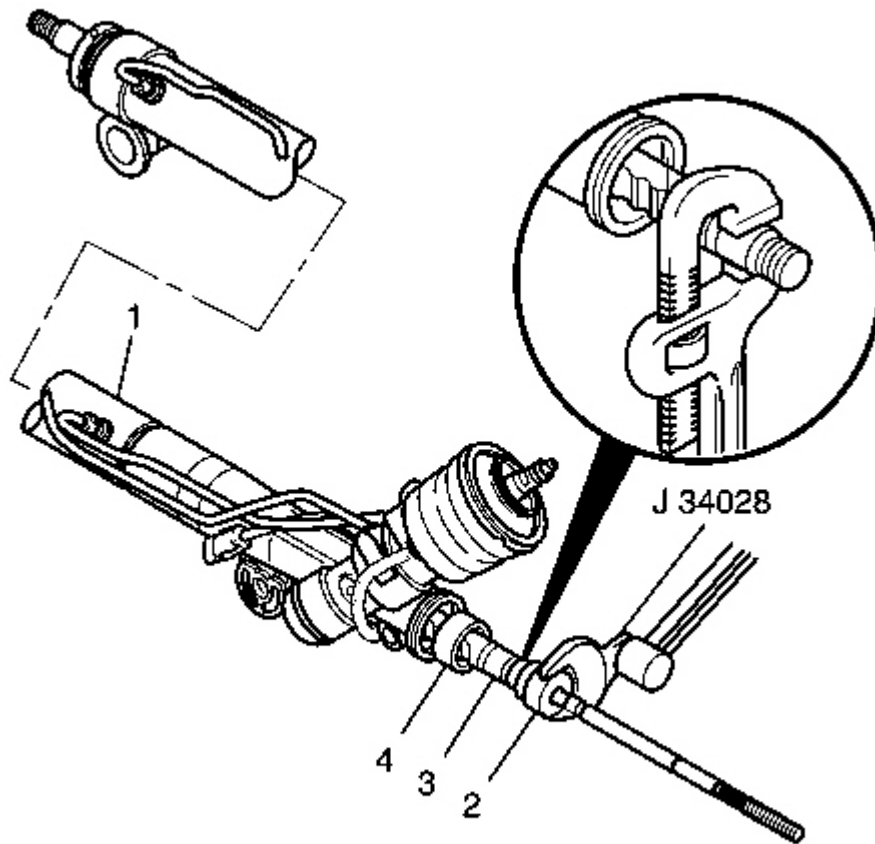


**Fig. 87: Identifying Tie Rod Male & Female Ends**  
Courtesy of GENERAL MOTORS CORP.

13. If female rack (1) and male inner tie rod (3), remove the old LOCTITE® from the threads (2) of the inner tie rod (3) and the rack (1).

If male rack (5) and female inner tie rod (4) LOCTITE® will not be present.

#### **Assembly Procedure**



**Fig. 88: View of Shock Dampener, Rack, Female/Male Inner Tie Rod with J 34028**  
Courtesy of GENERAL MOTORS CORP.

1. Slide the shock dampener (4) forward onto the rack (3).

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE®, or equivalent, container for expiration date. Use only enough LOCTITE® to evenly coat threads.

If male rack (3) and female inner tie rod (2) do not apply LOCTITE®.

2. If female rack (3) and male inner tie rod (2), apply LOCTITE® 262, or equivalent, to the inner tie rod threads.
3. Attach the inner tie rod onto the rack (3).

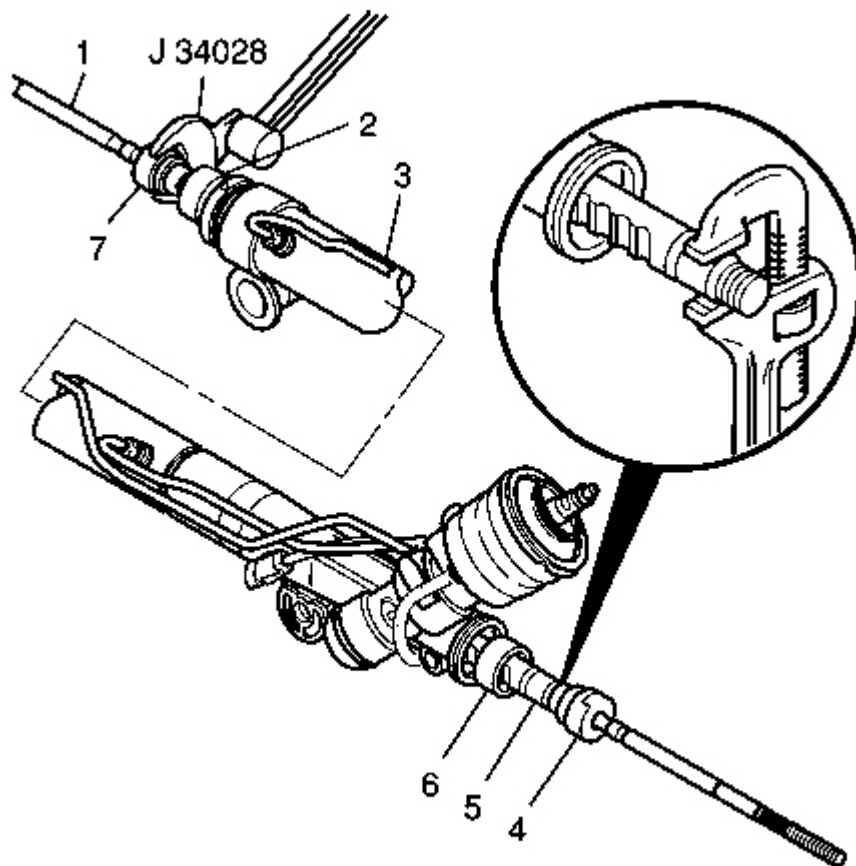
**NOTE:** Refer to Pipe Wrench Positioning Notice .

4. Place a pipe wrench on the rack (3) next to the inner tie rod housing (2).

**NOTE:** Refer to Fastener Notice .

5. Place a torque wrench and J 34028 on the flats of the inner tie rod housing (2). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



**Fig. 89: View of Shock Dampener, Female/Male Inner Tie Rod & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

6. Slide the shock dampener (2) forward onto the rack.

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**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE®, or equivalent, container for expiration date. Use only enough LOCTITE® to evenly coat threads.

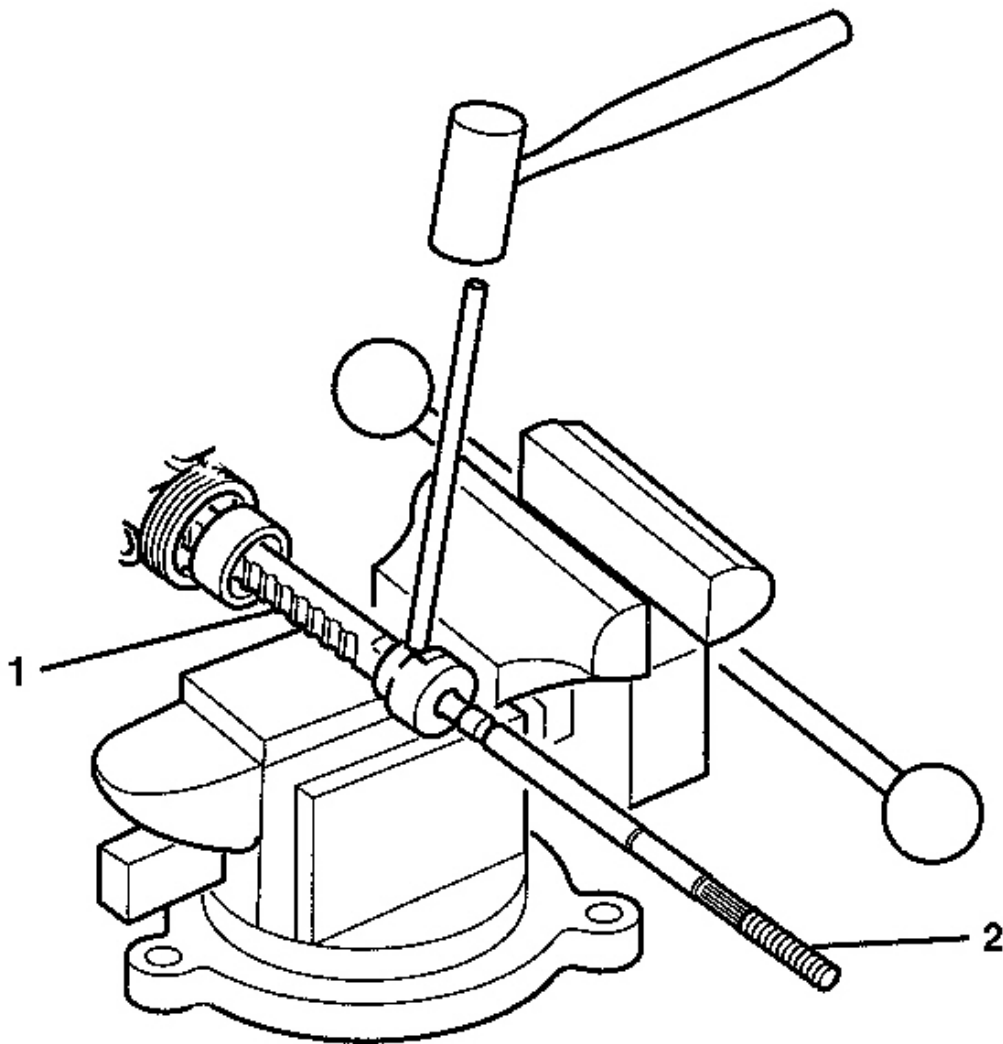
**If male rack and female inner tie rod (1) do not apply LOCTITE®.**

7. If female rack and male inner tie rod (1), apply LOCTITE® 262, or equivalent, to the inner tie rod threads.
8. Attach the inner tie rod (1) onto the rack.

**NOTE:** Refer to Pipe Wrench Positioning Notice .

9. Place a pipe wrench on the rack next to the inner tie rod housing (4).
10. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (7). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).

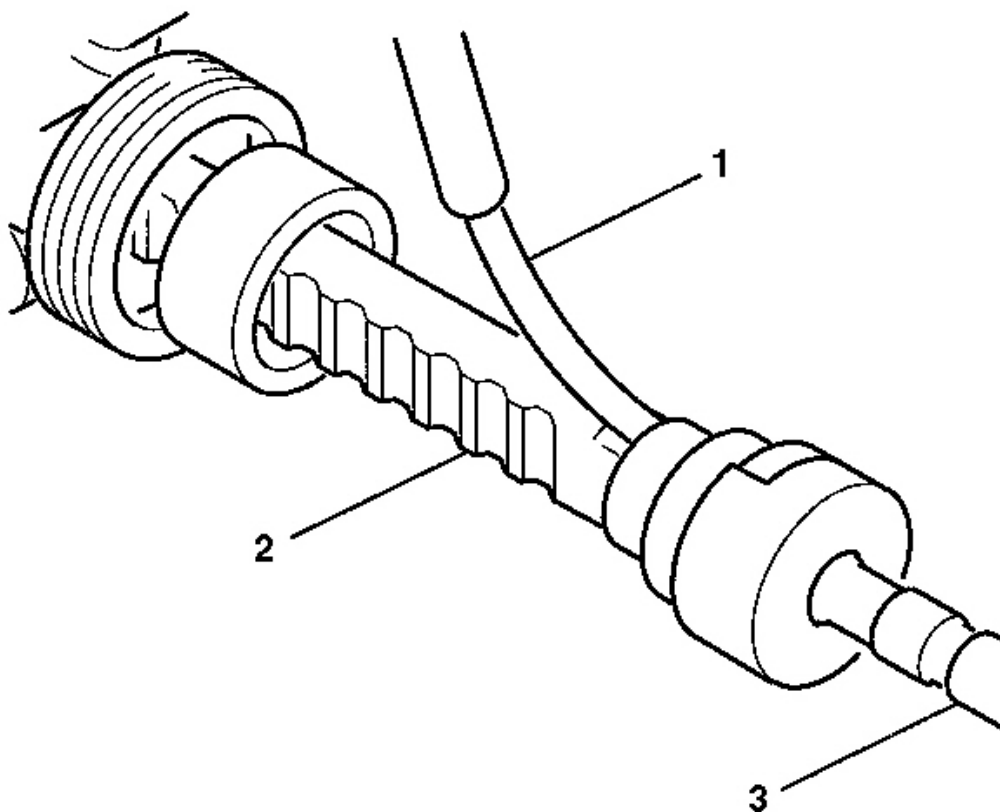


**Fig. 90: Staking Both Sides Of Female Inner Tie Rod Assembly Housing To Male Rack**  
Courtesy of GENERAL MOTORS CORP.

11. Place the inner tie rod assembly (2) in a vise.

**IMPORTANT: If female rack (1) and male inner tie rod (2) do not stake. If male rack (1) and female inner tie rod (2) you must stake.**

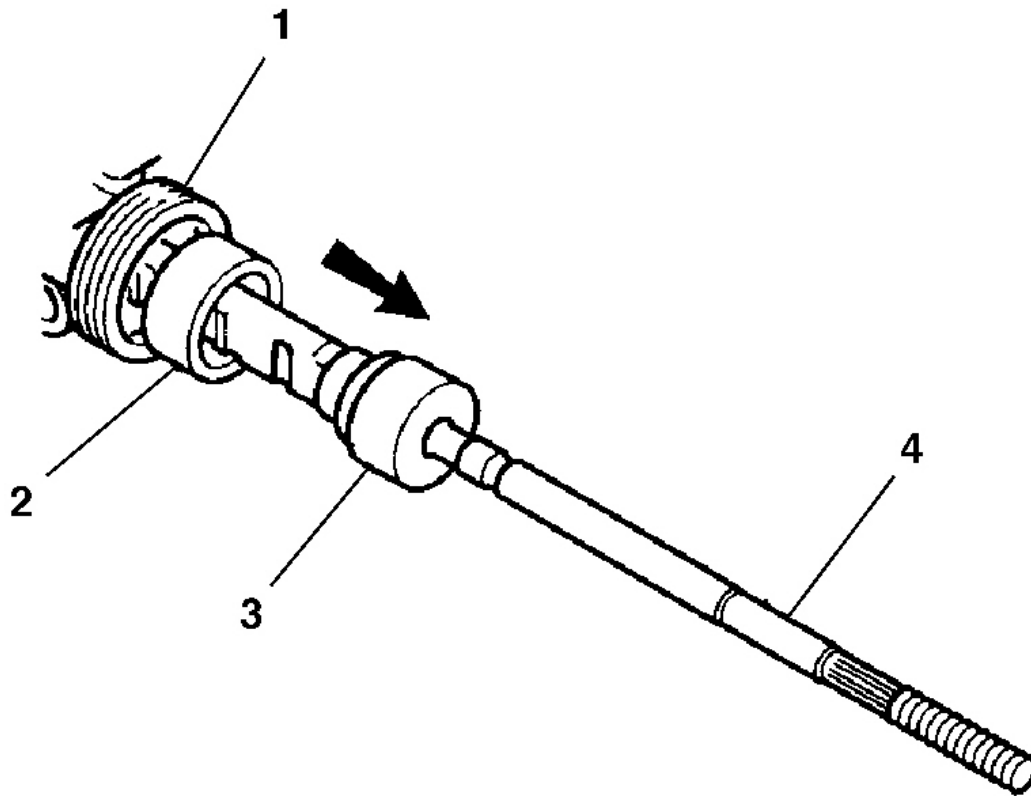
12. Stake both sides of the female inner tie rod assembly housing to the male rack (1).



**Fig. 91: Inserting Gage Between Rack & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

13. Insert a 0.25 mm gage (1) between the rack (2) and the inner tie rod housing in order to check both stakes. The feeler gage (1) must not pass between the rack and the housing stake.





**Fig. 92: Identifying Shock Dampener & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

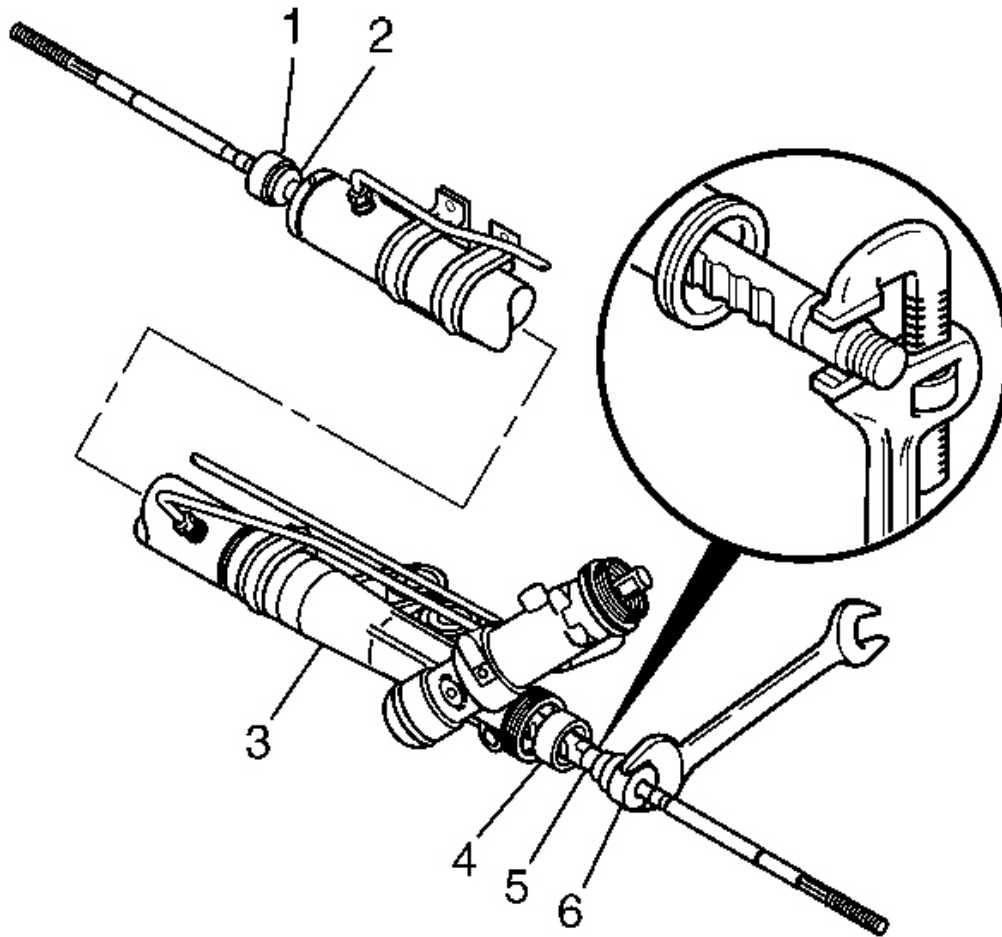
14. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
15. To assemble the rack and pinion boot. Refer to **Steering Gear Boot Replacement - Off Vehicle**.

## **STEERING GEAR INNER TIE ROD REPLACEMENT - OFF VEHICLE (QUIET VALVE)**

### **Tools Required**

**J 34028** Inner Tie Rod Wrench. See **Special Tools**.

### **Disassembly Procedure**



**Fig. 93: Identifying Inner Tie Rod Components**  
Courtesy of GENERAL MOTORS CORP.

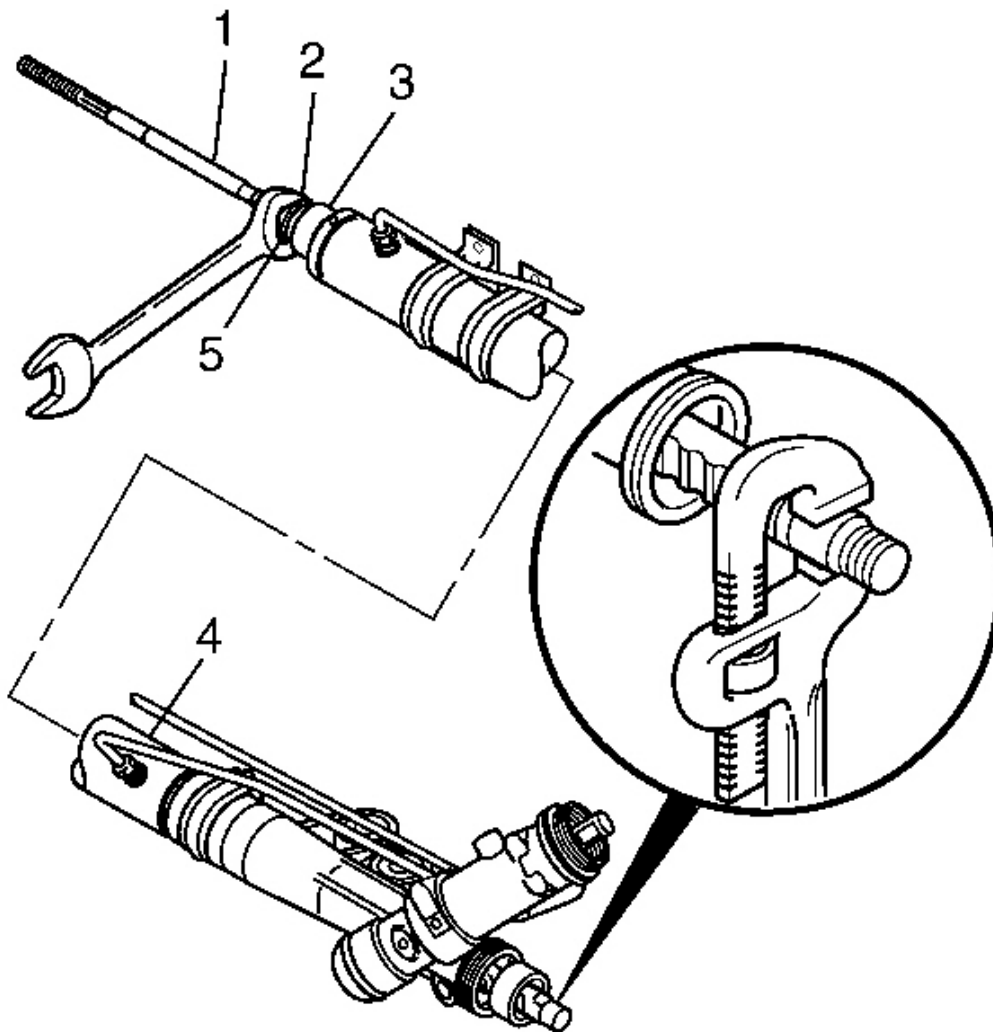
1. Remove the rack and pinion boot. Refer to Steering Gear Boot Replacement - Off Vehicle.
2. Place the gear in a vise.

**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

3. Remove the shock dampener (4) from the inner tie rod assembly (6).
4. Slide the shock dampener (4) back on the rack (5).

**NOTE:** Refer to Pipe Wrench Positioning Notice .

5. Place a pipe wrench on the rack (5) next to the inner tie rod housing (6).
6. Place a wrench on the flats of the inner tie rod housing (6).
7. Rotate the inner tie rod housing (6) counterclockwise, while holding the rack stationary, until the inner tie rod separates from the rack (5).



**Fig. 94: Separating Inner Tie Rod From Rack**  
Courtesy of GENERAL MOTORS CORP.

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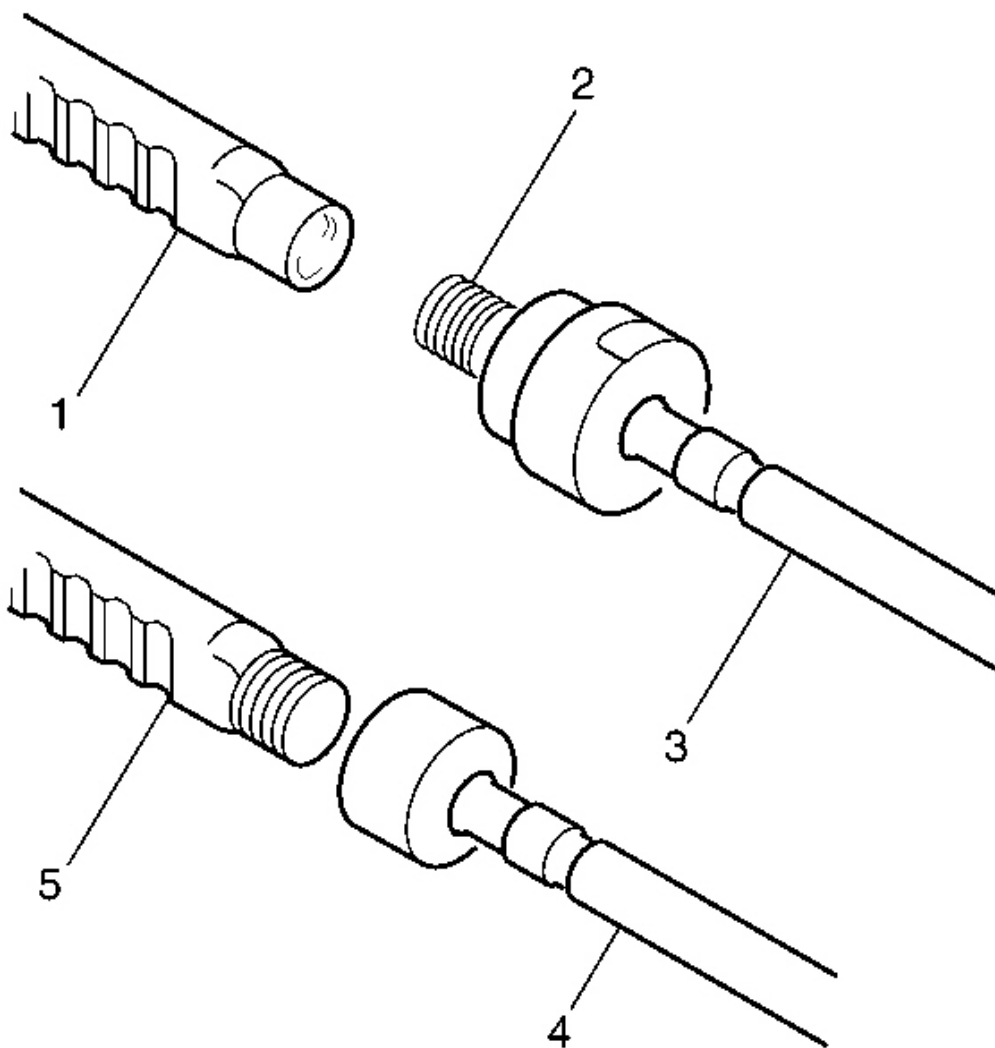
2008 STEERING Power Steering - Ascender, Envoy & Trailblazer

**NOTE:** Do not change the steering gear preload adjustment before moving the inner tie rod from the steering gear. Changing the steering gear preload adjustment before moving the inner tie rod could result in damage to the pinion and the steering gear.

8. Remove the shock dampener (3) from the inner tie rod housing (2).
9. Slide the shock dampener (3) back on the rack (5).

**NOTE:** Refer to Pipe Wrench Positioning Notice .

10. Place a pipe wrench on the rack.
11. Place a wrench on the flats of the inner tie rod housing (2).
12. Rotate the inner tie rod housing (2) counterclockwise, while holding the rack stationary, until the inner tie rod (1) separates from the rack (5).

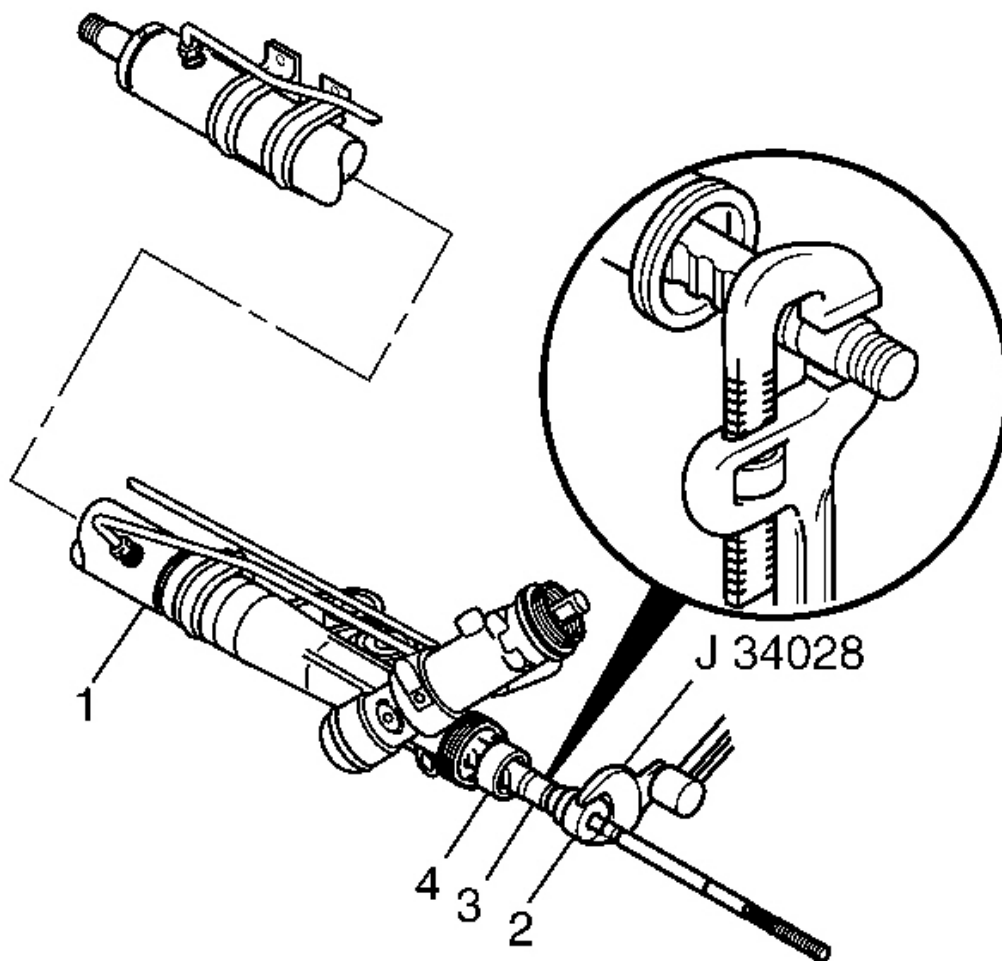


**Fig. 95: Identifying Tie Rod Male & Female Ends**  
Courtesy of GENERAL MOTORS CORP.

13. If female rack (1) and male inner tie rod (3), remove the old LOCTITE® from the threads (2) of the inner tie rod and the rack.

If male rack (5) and female inner tie rod (4) LOCTITE® will not be present.

**Assembly Procedure**



**Fig. 96: Connecting Inner Tie Rod To Rack**  
Courtesy of GENERAL MOTORS CORP.

1. Slide the shock dampener (4) forward onto the rack (3).

**IMPORTANT:** Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads.  
If male rack (3) and female inner tie rod (2) do not apply LOCTITE®.

2. If female rack (3) and male inner tie rod (2), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
3. Attach the inner tie rod onto the rack (3).

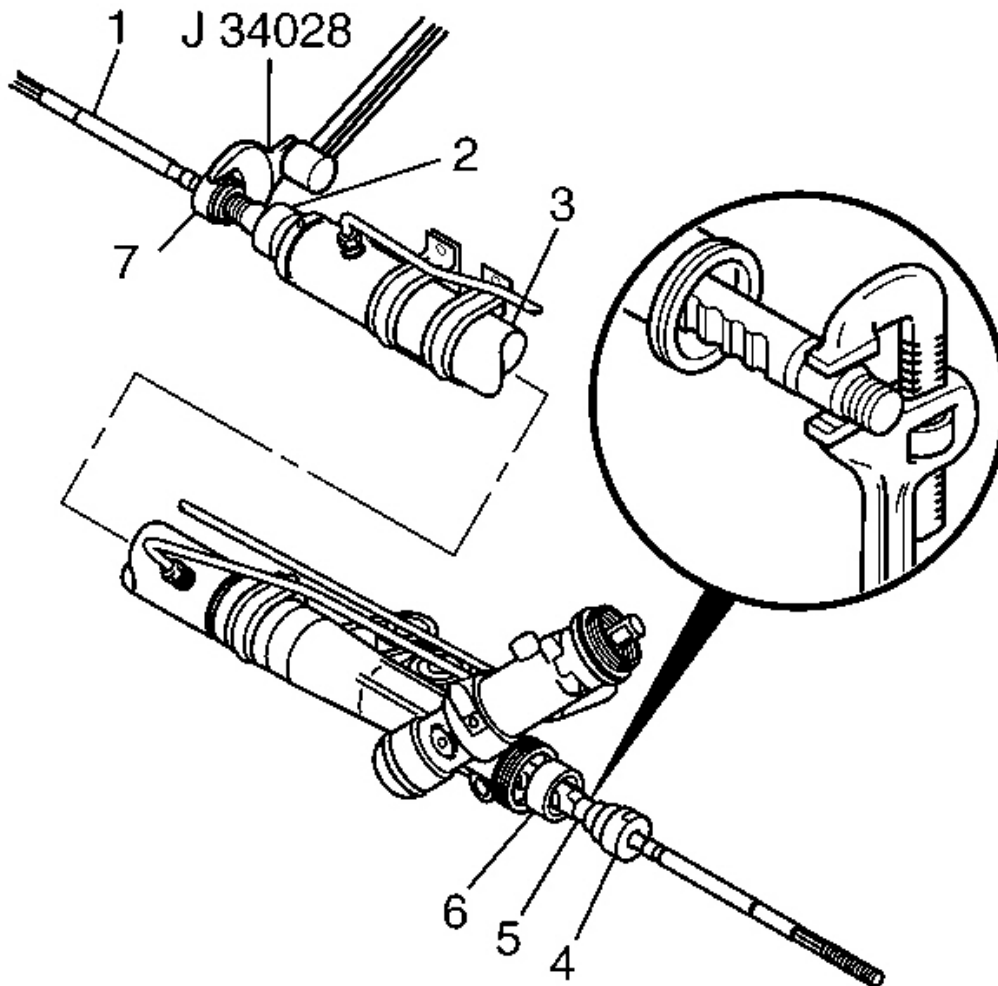
**NOTE:** Refer to Pipe Wrench Positioning Notice .

4. Place a pipe wrench on the rack (3) next to the inner tie rod housing (2).

**NOTE:** Refer to Fastener Notice .

5. Place a torque wrench and J 34028 on the flats of the inner tie rod housing (2). See Special Tools.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



**Fig. 97: Tightening Inner Tie Rod To Rack**  
Courtesy of GENERAL MOTORS CORP.

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6. Slide the shock dampener (2) forward onto the rack.

**IMPORTANT: Threads must be clean prior to LOCTITE® application. Check LOCTITE® or equivalent container for expiration date. Use only enough LOCTITE® to evenly coat threads.**

**If male rack and female inner tie rod (1) do not apply LOCTITE®.**

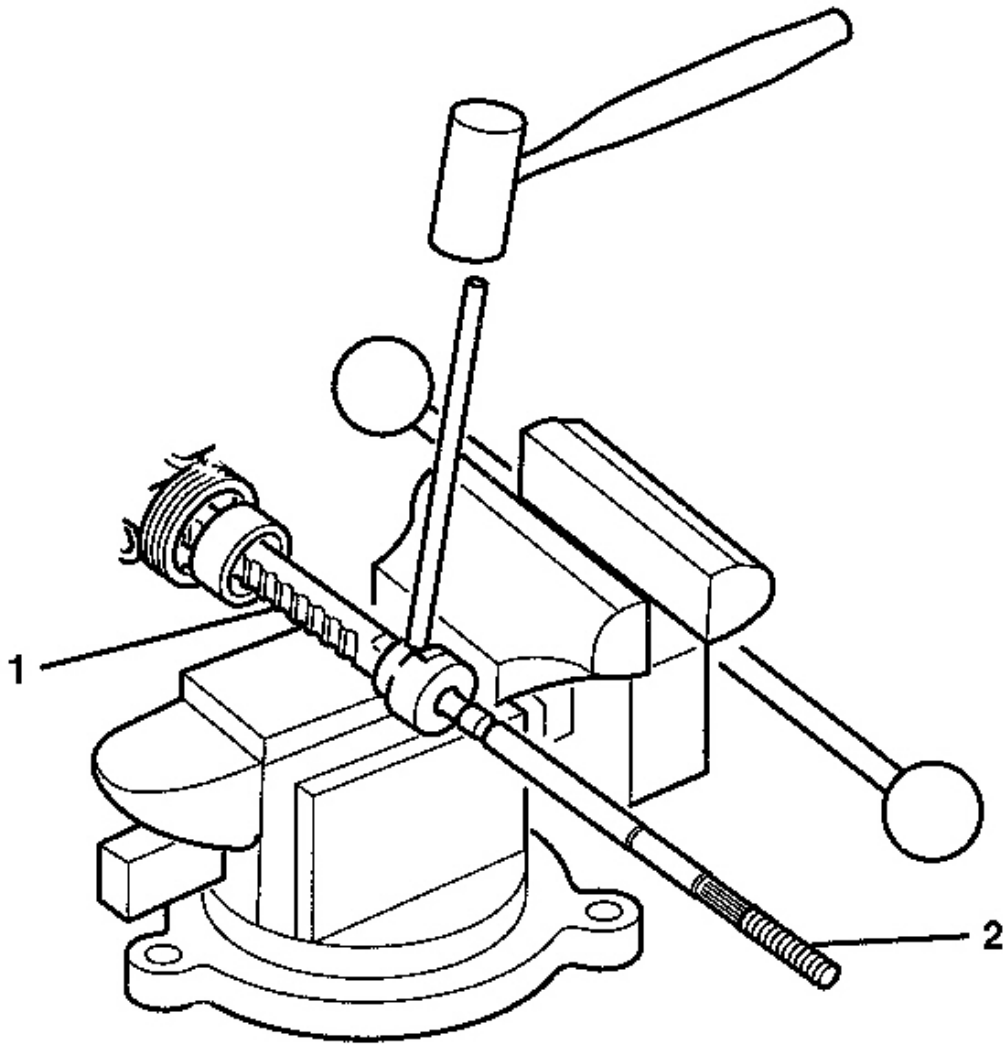
7. If female rack and male inner tie rod (1), apply LOCTITE® 262 or equivalent to the inner tie rod threads.
8. Attach the inner tie rod (1) onto the rack.

**NOTE: Refer to Pipe Wrench Positioning Notice .**

9. Place a pipe wrench on the rack next to the inner tie rod housing (4).
10. Place a torque wrench and **J 34028** on the flats of the inner tie rod housing (7). See **Special Tools**.

**Tighten:** Tighten the inner tie rod to 100 N.m (74 lb ft).



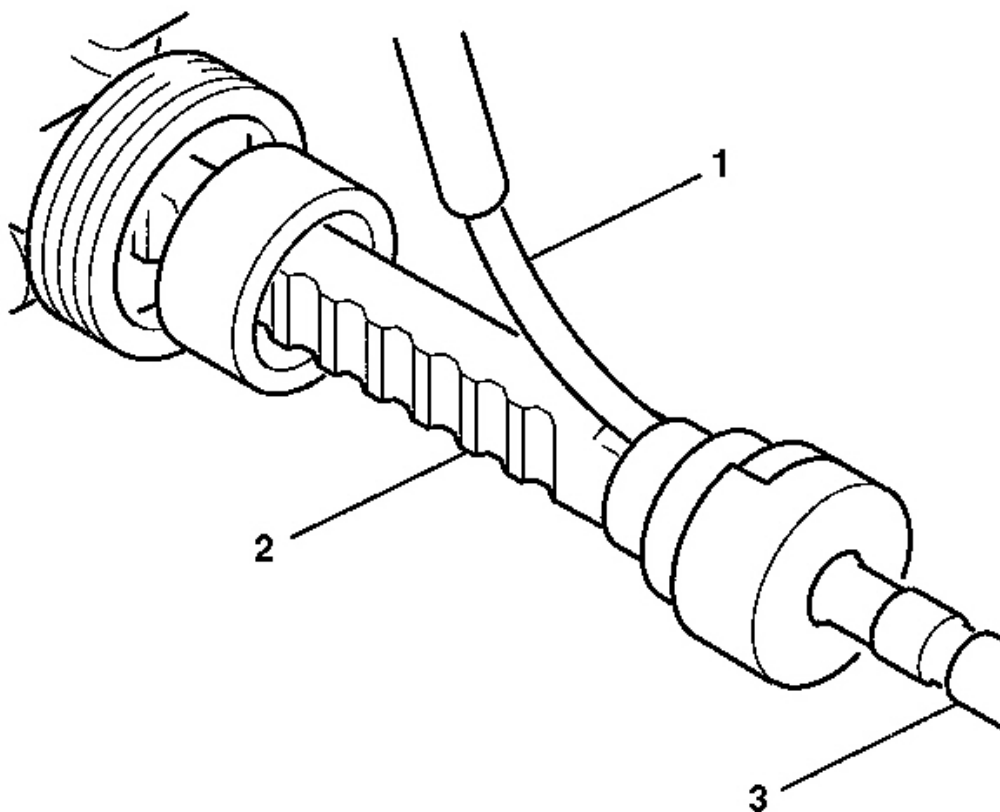


**Fig. 98: Staking Both Sides Of Female Inner Tie Rod Assembly Housing To Male Rack**  
Courtesy of GENERAL MOTORS CORP.

11. Place the inner tie rod assembly (2) in a vise.

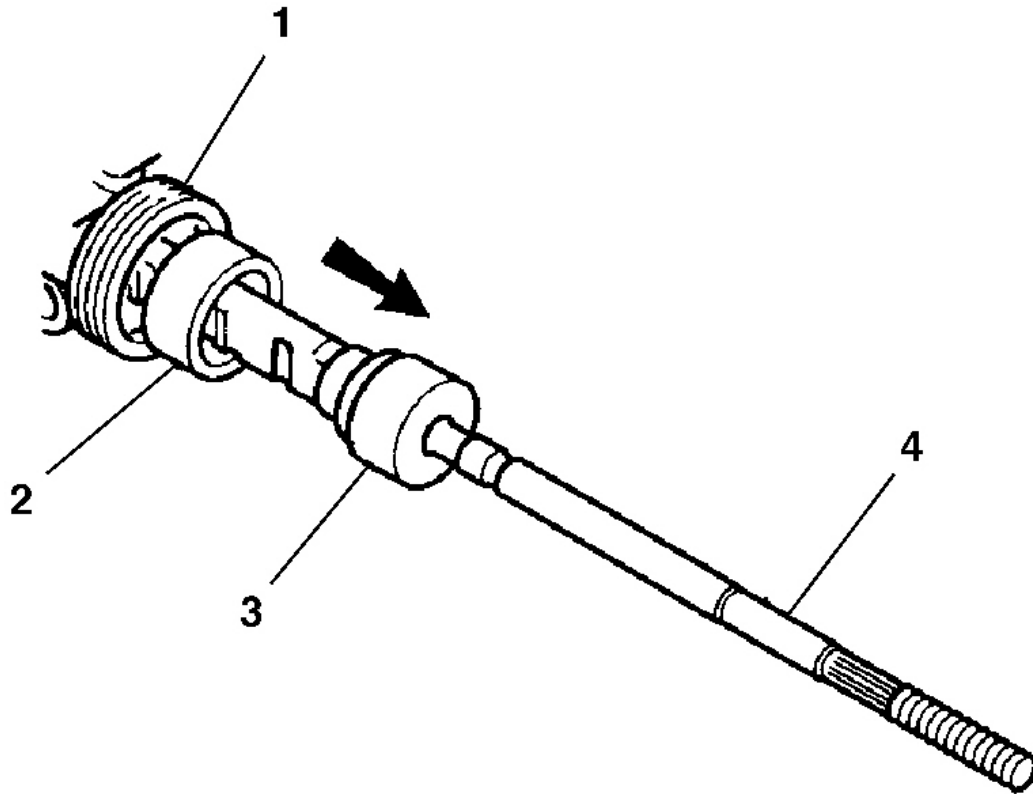
**IMPORTANT:** If female rack (1) and male inner tie rod (2) do not stake. If male rack (1) and female inner tie rod (2) you must stake.

12. Stake both sides of the female inner tie rod assembly housing to the male rack.



**Fig. 99: Inserting Gage Between Rack & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

13. Insert a 0.25 mm gage (1) between the rack (2) and the inner tie rod housing in order to check both stakes. The feeler gage (1) must not pass between the rack and the housing stake.

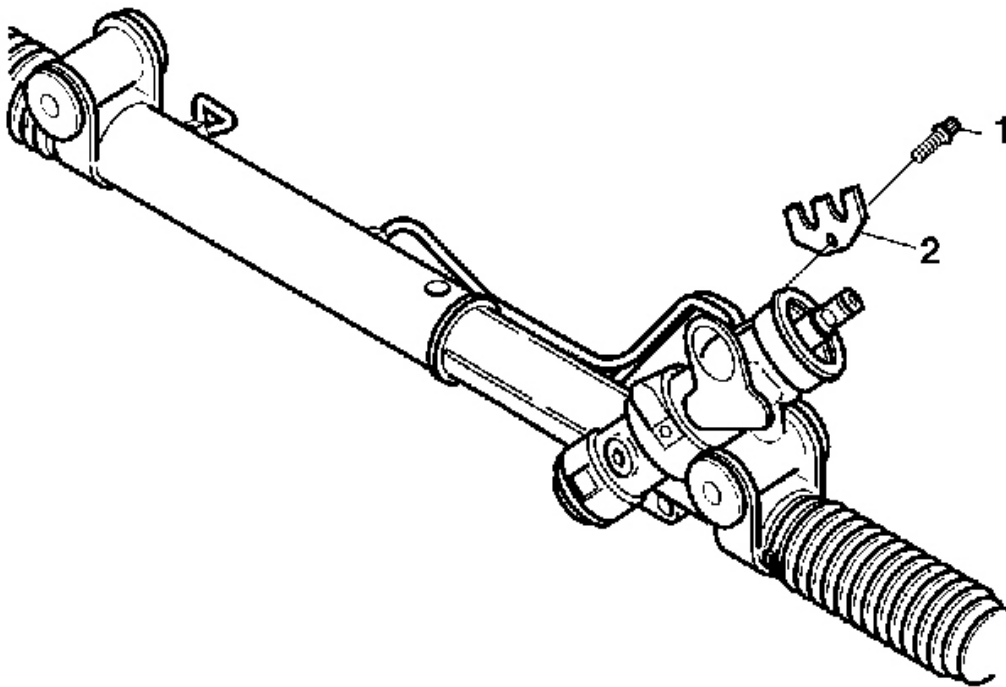


**Fig. 100: Identifying Shock Dampener & Inner Tie Rod Housing**  
Courtesy of GENERAL MOTORS CORP.

14. Slide the shock dampener (2) over the inner tie rod housing (3) until the front lip of the shock dampener (2) bottoms against the inner tie rod housing (3).
15. To assemble the rack and pinion boot. Refer to **Steering Gear Boot Replacement - Off Vehicle**.

## **STEERING GEAR CYLINDER PIPE ASSEMBLY & SEALS REPLACEMENT - OFF VEHICLE**

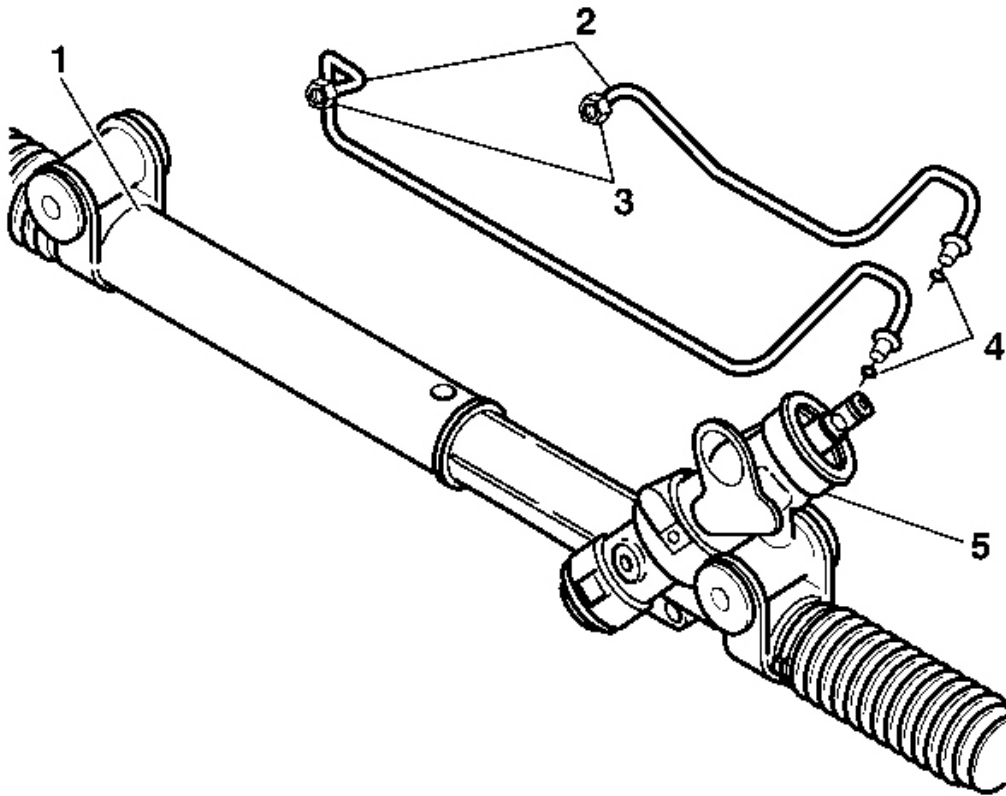
### **Removal Procedure**



**Fig. 101: View Of Cylinder Line Retaining Plate & Screw**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Protect the boots from sharp tools and from the sharp edges of surrounding components.

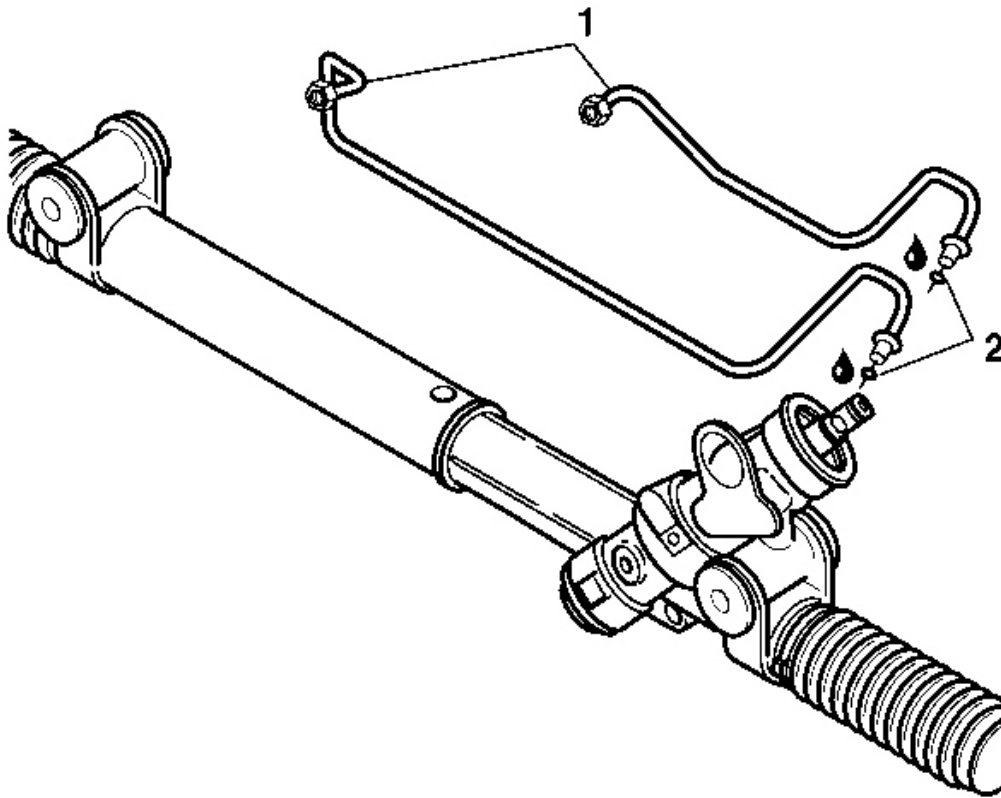
1. Remove the TORX® screw (1) from the cylinder line retaining plate (2) at the valve end.
2. Remove the cylinder line retaining plate (2).



**Fig. 102: View Of Cylinder Line Assemblies & Gear Assembly**  
Courtesy of GENERAL MOTORS CORP.

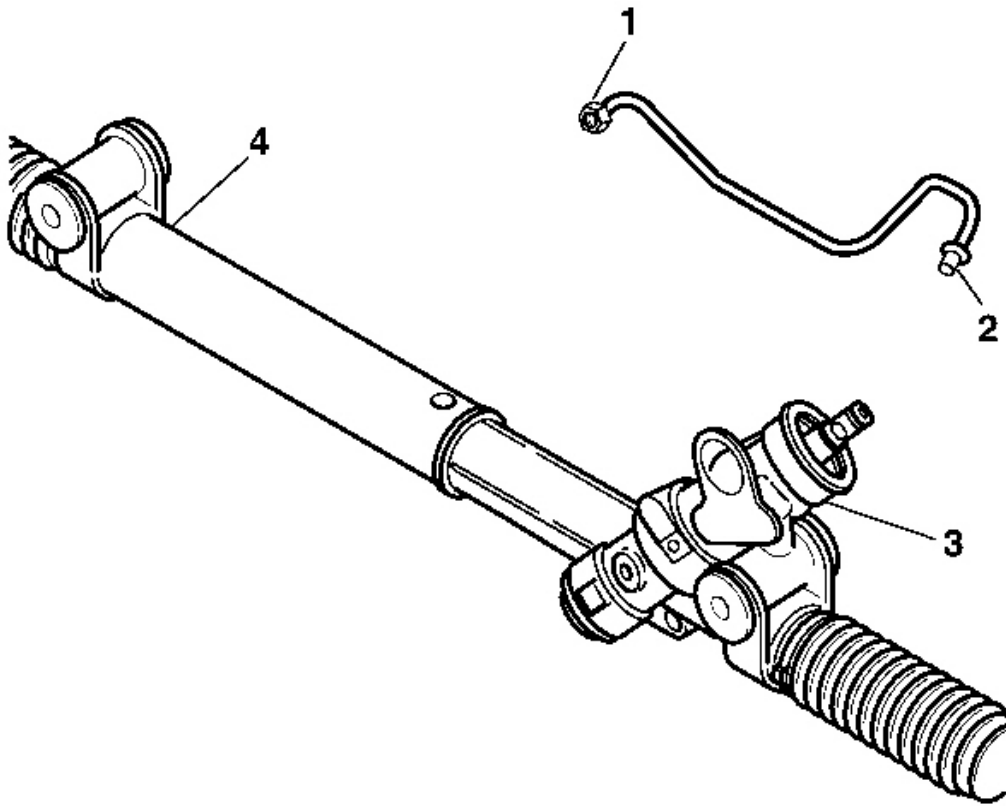
3. Loosen both cylinder line nuts (3) on cylinder end of the gear assembly (1).
4. Remove both cylinder line assemblies (2) from the rack and pinion gear assembly (1).
5. Remove and discard the O-rings seals (4) from the valve end (5).

#### **Installation Procedure**



**Fig. 103: Inspecting Cylinder Lines**  
Courtesy of GENERAL MOTORS CORP.

1. Inspect the cylinder lines (1) for the following items:
  - Cracks
  - Dents
  - Damage to the threads
2. Replace the parts as needed.
3. Lubricate and install the O-rings seals (2) onto the cylinder lines (1).



**Fig. 104: Identifying Steering Gear Cylinder Pipe At Valve End Of Steering Gear**  
Courtesy of GENERAL MOTORS CORP.

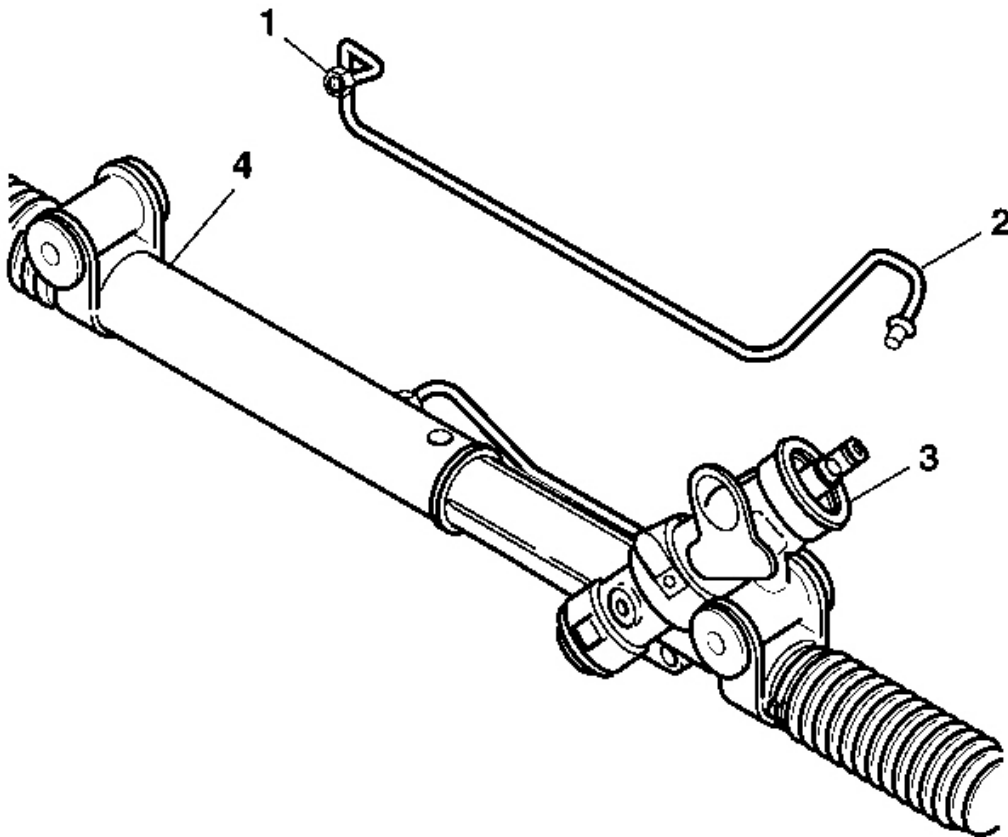
**IMPORTANT:** You must install the smaller cylinder line into the valve housing (3) first.

4. Place the smaller cylinder line (2) into the valve housing (3).

**IMPORTANT:** Hold the smaller cylinder line (2) in place. Do not torque the cylinder line nut (1).

5. Place the other end of the cylinder line at the gear tube end (4).

Finger tighten the cylinder line nut (1) on the smaller cylinder line.



**Fig. 105: Identifying Larger Cylinder Line At Valve Housing**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** You must install the larger cylinder line into the valve housing (3) first.

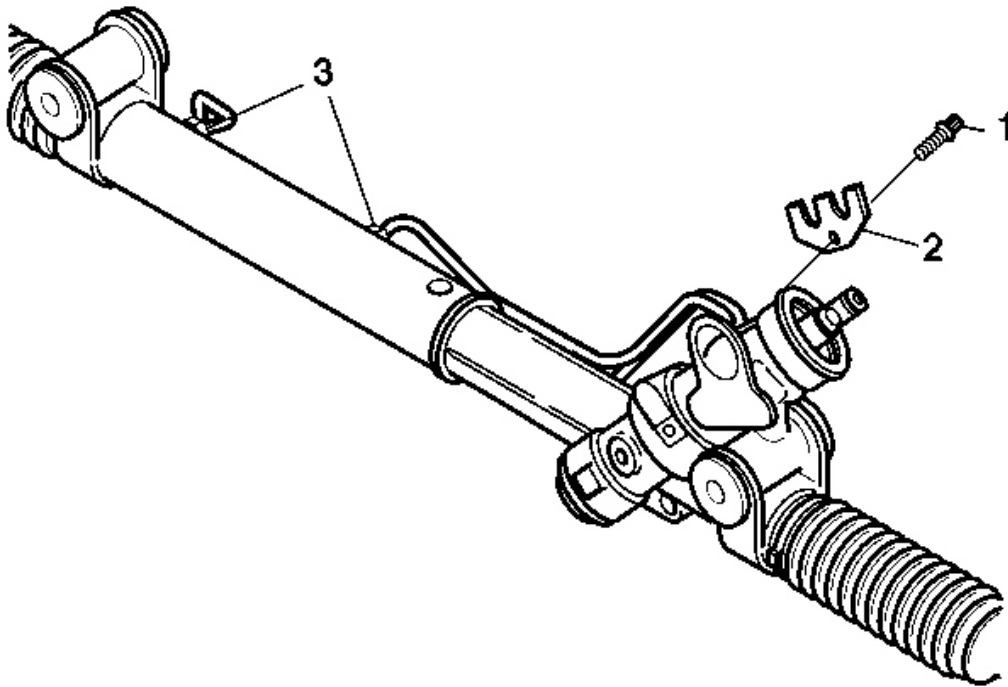
6. Place the larger cylinder line (2) into the valve housing (3).

**IMPORTANT:** Hold the larger cylinder line (2) in place. Do not torque the cylinder line nut (1).

7. Place the other end of the cylinder line at the gear tube end (4).

Finger tighten the cylinder line nut (1) on the larger cylinder line.





**Fig. 106: Identifying Steering Gear Cylinder Pipe Retaining Plate**  
Courtesy of GENERAL MOTORS CORP.

8. Place the cylinder line retaining plate (2) over the cylinder line beads at the valve end.

**NOTE:** Refer to Fastener Notice .

9. Install the TORX® screw (1) into the cylinder line retaining plate (2) and tighten using an E 8 socket.

**Tighten:** Tighten the screw to 12 N.m (106 lb in).

10. Tighten both cylinder line nuts (3) at the cylinder end.

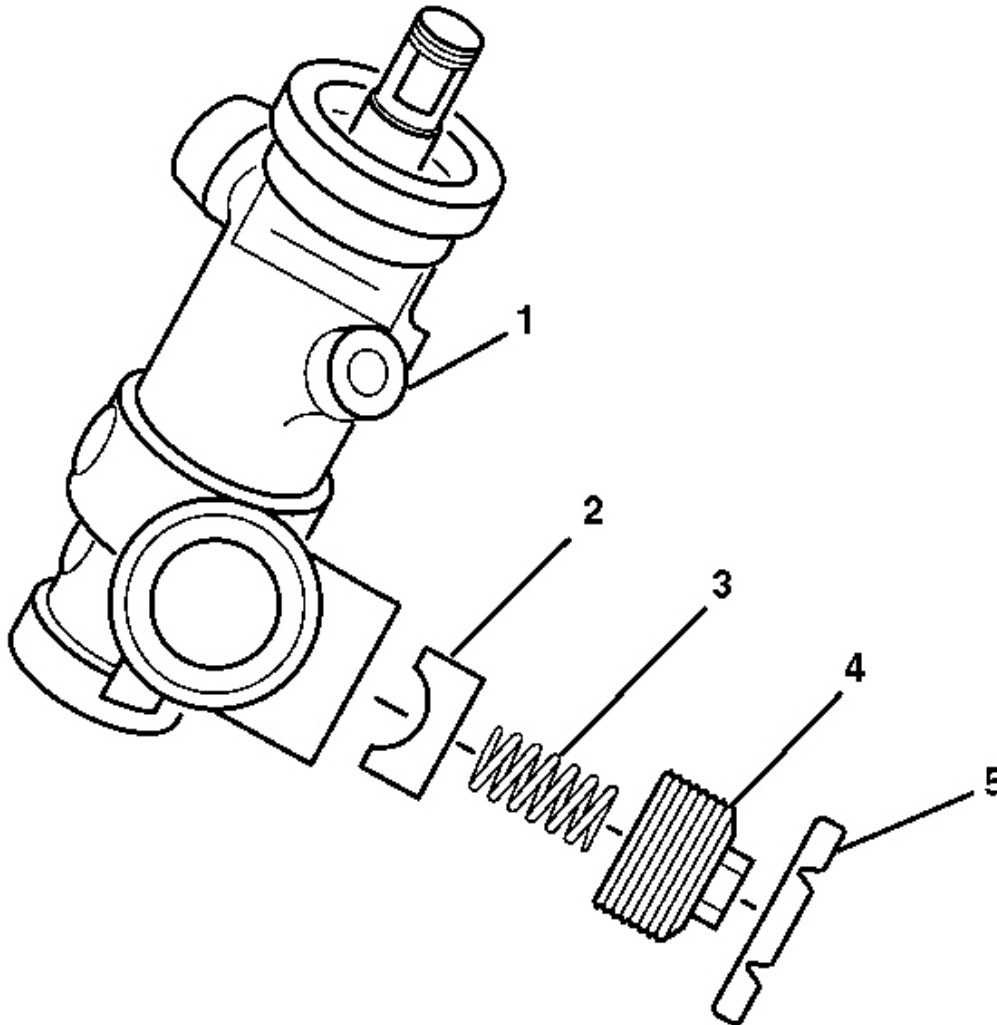
**Tighten:** Tighten the nuts to 32 N.m (24 lb ft).

## STEERING GEAR STUB SHAFT SEAL & BEARING REPLACEMENT - OFF VEHICLE

### Tools Required

**J 29810** Stub Shaft Seal Protector

**Disassembly Procedure**



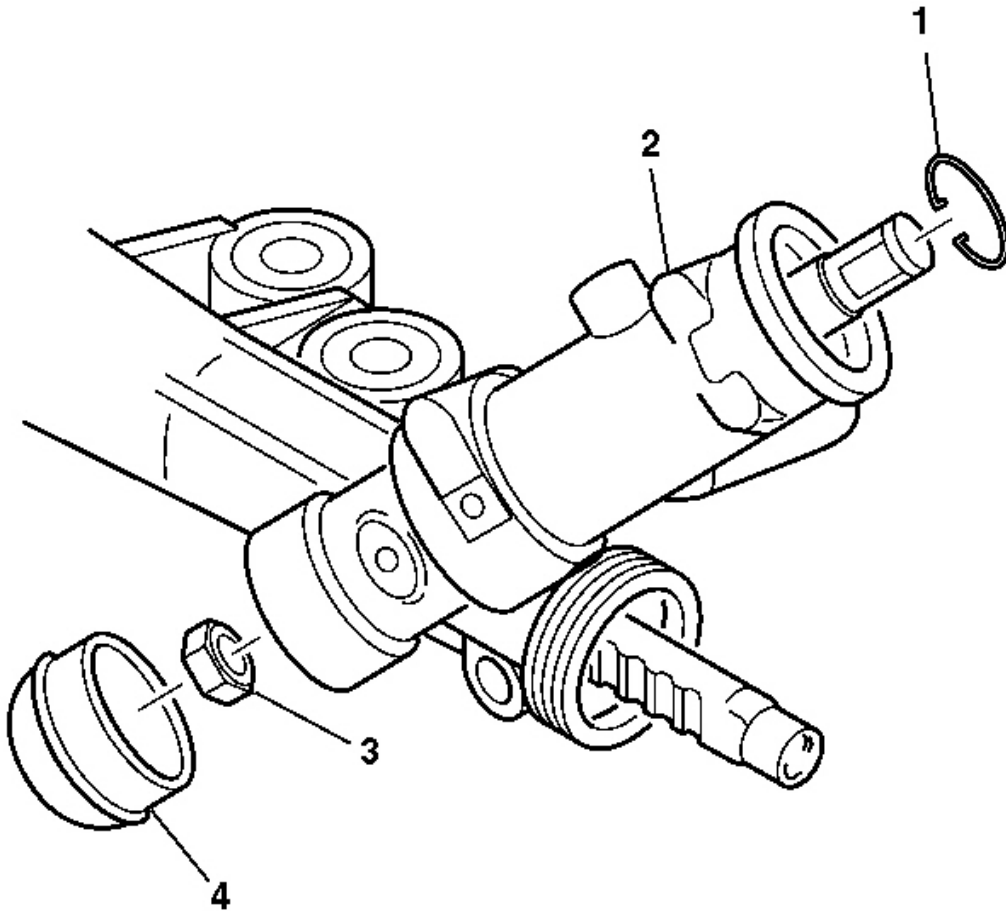
**Fig. 107: View Of Adjuster Plug, Plug Lock Nut, Spring & Rack Bearing**  
Courtesy of GENERAL MOTORS CORP.

1. To remove the rack and pinion steering assembly, refer to **Steering Gear Boot Replacement - Off Vehicle**.

Remove the adjuster plug lock nut (5) from the adjuster plug (4).

2. Remove the adjuster plug (4) from the gear assembly (1).

3. Remove the adjuster spring (3) and the rack bearing (2).

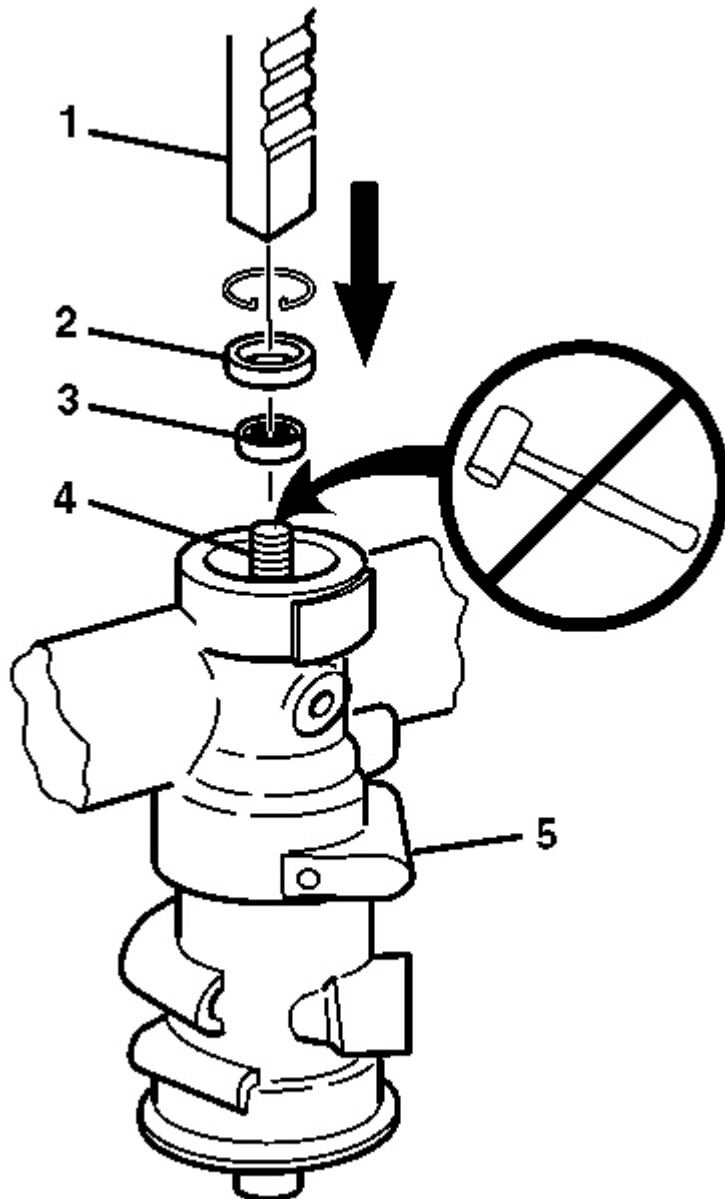


**Fig. 108: View Of Hex Lock Nut At Lower End Of Pinion & Valve Assembly**  
Courtesy of GENERAL MOTORS CORP.

4. Remove the retaining ring (1) from the valve bore of the rack and pinion gear assembly (2).
5. Remove the dust cover (4) from the bottom of the rack and pinion gear assembly (2).

**IMPORTANT: The stub shaft must be held to prevent damage to the pinion teeth.**

6. Remove the hex lock nut (3) from the lower end of the pinion and valve assembly while holding the stub shaft with a 14 mm crowfoot wrench.



**Fig. 109: View Of Stub Shaft Bearing Annulus & Stub Shaft Seal**  
Courtesy of GENERAL MOTORS CORP.

**IMPORTANT:** Do not hammer or pound on pinion or valve assembly. This will cause damage or loosen the drive pin.

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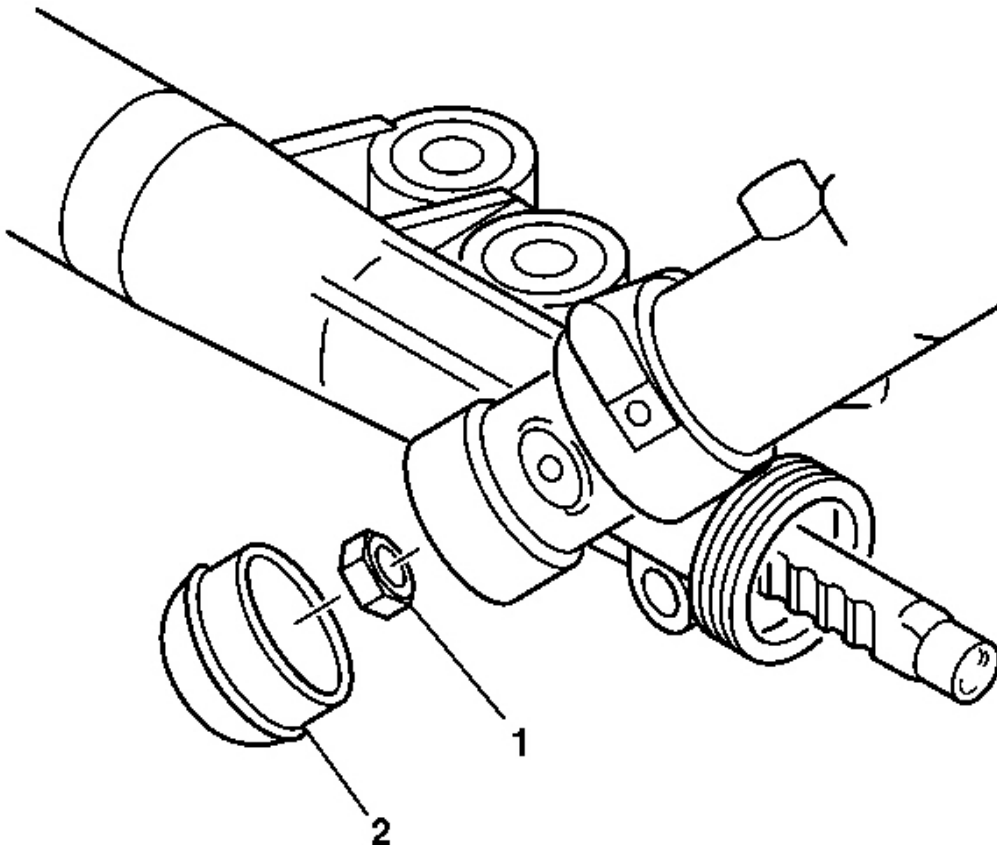
**When performing the following procedure, do not remove the pinion and valve assembly from the rack and pinion gear assembly (5).**

7. Press the pinion and valve assembly only far enough to allow removal of the stub shaft bearing annulus (3) and the stub shaft seal (2).

Using an arbor press (1), press on the threaded end of the pinion until removal of the following items is possible:

1. The stub shaft (4)
2. The stub shaft seal (2)
3. The stub shaft bearing annulus assembly (3)

### Assembly Procedure



**Fig. 110: View Of Hex Lock Nut At Pinion**  
Courtesy of GENERAL MOTORS CORP.

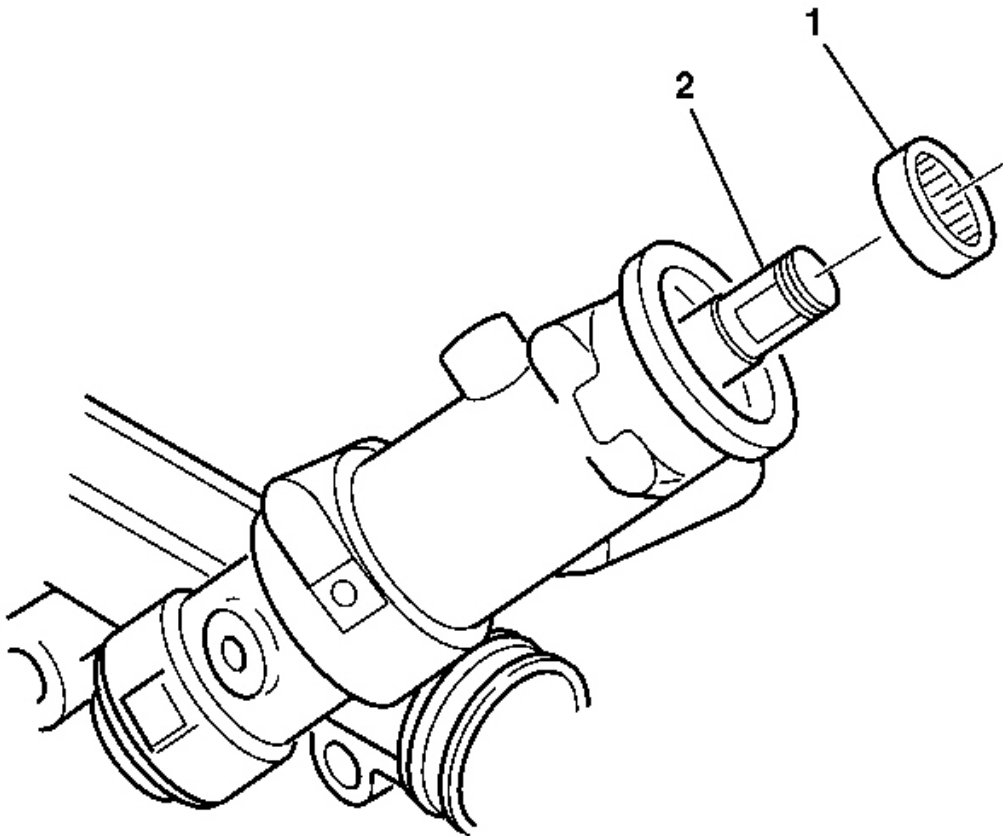
**NOTE:** Refer to Fastener Notice .

**IMPORTANT:** The stub shaft must be held to prevent damage to the pinion teeth.

1. Install the hex lock nut (1) onto the pinion while holding the valve stub shaft.

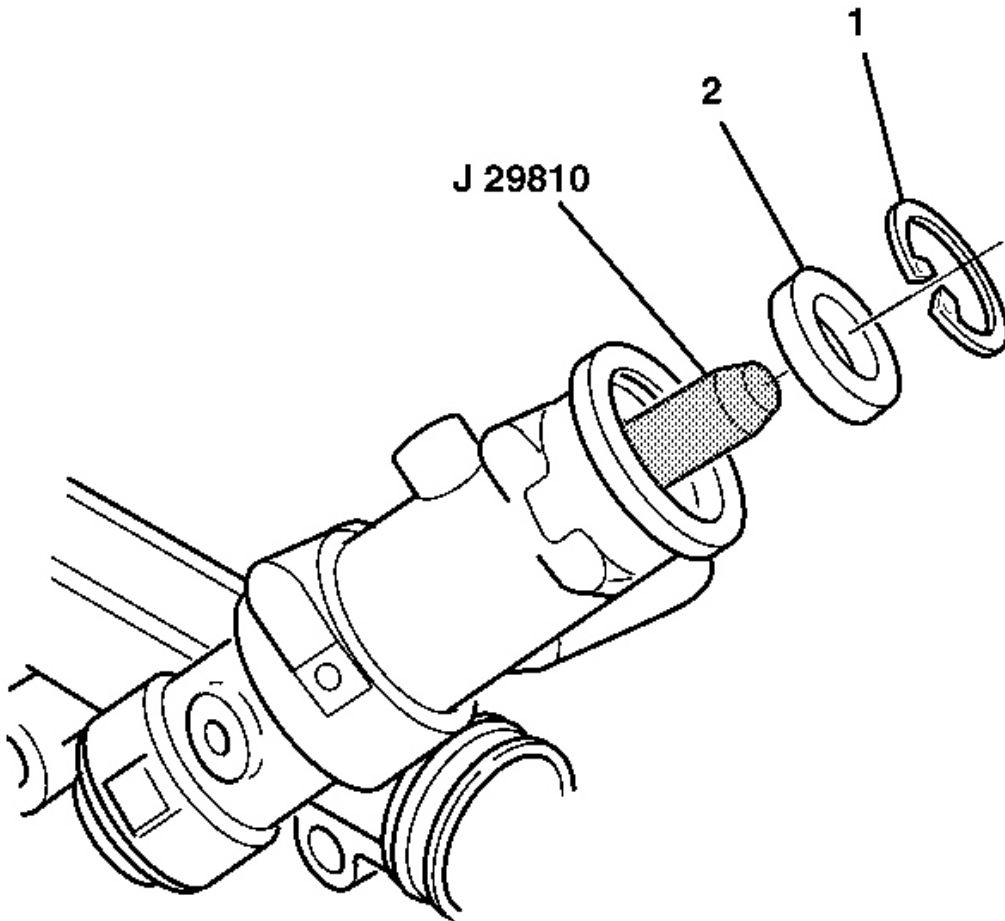
**Tighten:** Tighten the hex lock nut (1) to 30 N.m (22 lb ft).

2. Install the dust cover (2) to the rack and pinion gear assembly.



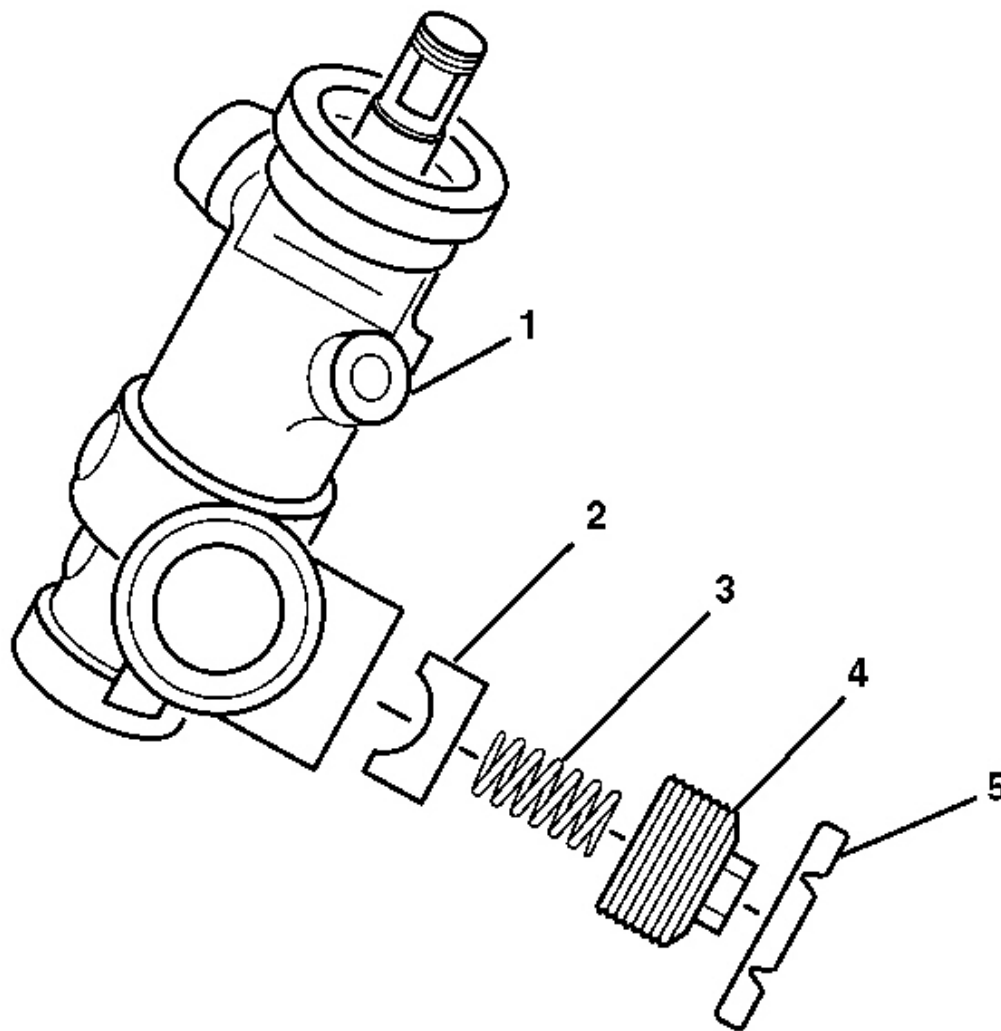
**Fig. 111: Stub Shaft Bearing Annulus Assembly At Valve Stub Shaft**  
Courtesy of GENERAL MOTORS CORP.

3. Install the stub shaft bearing annulus assembly (1) onto the valve stub shaft (2).



**Fig. 112: View Of Retaining Ring, Stub Shaft Seal & Rack & Pinion Gear Assembly**  
Courtesy of GENERAL MOTORS CORP.

4. Install **J 29810** onto the valve stub shaft.
5. Lubricate the stub shaft seal (2) with grease.
6. Install the stub shaft seal (2) into the rack and pinion gear assembly.
7. Install the retaining ring (1) into the groove in the rack and pinion gear assembly.



**Fig. 113: View Of Adjuster Plug, Plug Lock Nut, Spring & Rack Bearing**  
**Courtesy of GENERAL MOTORS CORP.**

8. Lubricate the following items with lithium base grease:
  1. The rack bearing (2)
  2. The adjuster spring (3)
  3. The adjuster plug (4)
9. Install the following items into the gear assembly:
  1. The rack bearing (2)



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2. The adjuster spring (3)
3. The adjuster plug (4)
10. Turn the adjuster plug (4) clockwise onto the rack and pinion gear assembly (1) until the adjuster plug (4) bottoms in the rack and pinion gear assembly (1).
11. Turn the adjuster plug (4) back 50 degrees to 70 degrees.
12. Check the rotational torque on the pinion. The maximum pinion preload torque is 1.8 N.m (16 lb in).
13. Install the adjuster plug lock nut (5) to the adjuster plug (4).

Finger tighten the adjuster plug lock nut (5) while holding the adjuster plug (4) stationary.

**Tighten:** Tighten the nut to 68N.m (50 lb ft).

14. To install the rack and pinion assembly onto the vehicle, refer to **Steering Gear Boot Replacement - Off Vehicle**.

**IMPORTANT:** Flush and bleed power the steering system (hoses, reservoir and cooler lines) with power steering fluid GM P/N 89020661 or P/N 89021184 or equivalent, meeting GM Specification number 9985010.

Refer to **Power Steering System Bleeding**.

## DESCRIPTION & OPERATION

### POWER STEERING SYSTEM DESCRIPTION & OPERATION (W/O ELECTRO-HYDRAULIC STEERING)

The hydraulic power steering pump is a constant displacement vane-type pump that provides hydraulic pressure and flow for the power steering gear. The hydraulic power steering pumps are either belt-driven or direct-drive, cam-driven.

The power steering fluid reservoir holds the power steering fluid and may be integral with the power steering pump or remotely located. The following locations are typical locations for the remote reservoir:

- Mounted to the front of the dash panel
- Mounted to the inner fender
- Mounted to a bracket on the engine

The 2 basic types of power steering gears are listed below:

- A recirculating ball system
- A rack and pinion system

In the recirculating ball system, a worm gear converts steering wheel movement to movement of a sector shaft. A pitman arm attached to the bottom of the sector shaft actually moves one tie rod and an intermediate rod

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move the other tie rod.

In the rack and pinion system, the rack and the pinion are the 2 components that convert steering wheel rotation to lateral movement. The steering shaft is attached to the pinion in the steering gear. The pinion rotates with the steering wheel. Gear teeth on the pinion mesh with the gear teeth on the rack. The rotating pinion moves the rack from side to side. The lateral action of the rack pushes and pulls the tie rods in order to change the direction of the vehicle's front wheels.

The power steering pressure hose connects the power steering pump union fitting to the power steering gear and allows pressurized power steering fluid to flow from the pump to the gear.

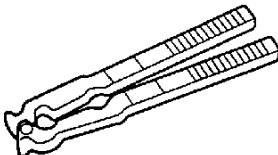
The power steering return hose returns fluid from the power steering gear back to the power steering fluid reservoir. The power steering return line may contain an integral fin-type or line-type power steering fluid cooler.

In a typical power steering system, a pump generates hydraulic pressure, causing fluid to flow, via the pressure hose, to the steering gear valve assembly. The steering gear valve assembly regulates the incoming fluid to the right and left chambers in order to assist in right and left turns.

Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front wheels, which turn the vehicle right or left.

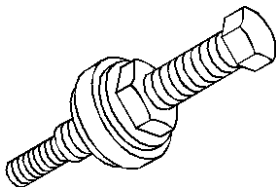
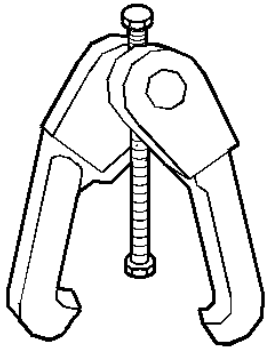
## SPECIAL TOOLS & EQUIPMENT

### SPECIAL TOOLS

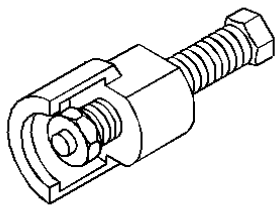
Illustration	Tool Number/ Description
	J 22610 Keystone Clamp Pliers
	J 24319-B Steering Linkage and Tie Rod Puller

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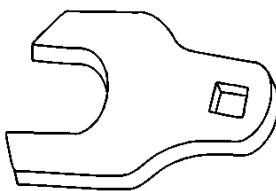
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J 25033-C  
Pulley Installer



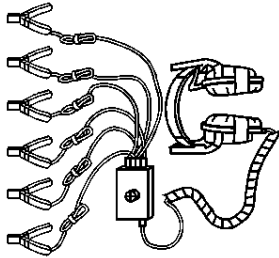
J 25034-C  
Pulley Remover



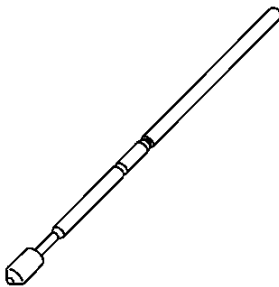
J 34028  
Inner Tie Rod Wrench

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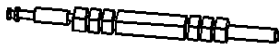
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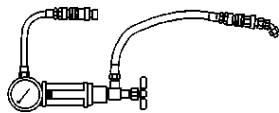
J 39570  
Chassis Ear



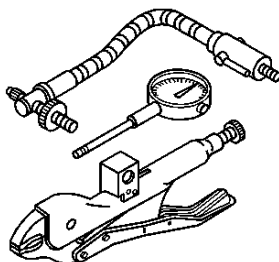
J 42640  
Steering Column Anti-Rotation Pin



J 44586  
Power Steering Gear Oil Seal Remover/Installer



J 44721  
Power Steering Analyzer



J 45101  
Hub and Wheel Runout Gage